The New Zealand
Journal of Agriculture.

VOL. 42. WELLINGTON, 20TH JUNE, 1931. No. 6.

FEEDING OF IRON IN BUSH SICKNESS.

SOME RECENT WORK WITH SHEEP.

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Use of Local Iron Supplies.

LOOKING for a supply of an iron compound which might take the place of the comparatively costly double citrate of iron and ammonium for the prevention and cure of bush sickness, the writer had three possible sources: (1) The limonite of Onekaka, Nelson; (2) the bog-iron of swamps near Whangarei; (3) the various deposits of siderite (spathic iron-ore) which occur throughout New Zealand.

In March, 1925, 3 tons of Onekaka iron was received in the pulverized state and sent to Mamaku Demonstration Farm. This material is still being used in lick experiments in the Rotorua district. About the same time inquiries were instituted regarding the Whangarei deposits, and arrangements have been made to test this form of iron thoroughly. The owners of both these deposits are turning out hydrated iron oxide as a commercial product which is being used by gasworks in the purification of coal-gas. This material is cheaper and softer and therefore more easily ground than the spathic ore, and has the advantage of containing by weight twice as much iron. It seemed, however, advisable to experiment with the native carbonate of iron first, as there appeared to be a probability of it being more assimilable by the animal than the hydrated oxide. The great success which has attended the use of Scotch bog-iron in preventing bush sickness in Kenya* suggested that New Zealand limonite might prove equally efficacious and far less costly to produce than the carbonate or the citrate. The occurrence of native carbonate of iron (ferrous carbonate) has been recorded by collectors in both Islands of New Zealand from several localities, Huntly being one of these.

Early in 1926 the writer visited the clay-pit of the Huntly Pipe and Tile Co., quite near the Huntly Railway-station, and identified the large deposit of discarded boulders as spathic iron-ore. Mr. Greenwell,

* Sixth Report on Mineral Content of Natural Pastures. Economic Advisory Council, 1931.

the works manager, gave every assistance and sent several boulders to Wellington, where with great difficulty they were broken and roughly crushed, and finally ground to a fine powder. Finally, through the kindness of Messrs. Jackson and Co., paint-manufacturers, of Wingfield Street, some 5 cwt. was pulverized in a paint-making mill and forwarded to the bush-sick districts for trial. The usual delay in getting positive results then occurred; objections arose to the use of this water-insoluble material, and difficulties in grinding large quantities had to be overcome. The Huntly Company and the Challenge Phosphate Co. were, however, very helpful. The Challenge Company ground and bagged the material free of charge, while the Huntly Company went to considerable trouble in handling the raw material, rough grinding large quantities with very inadequate appliances, and trucking it to Auckland to be finely pulverized in a phosphate-mill. The Department of Agriculture obtained an option over this deposit, and the option is still in force.

It was not until 1929 that encouraging results began to be obtained from the use of the material as a lick. A dairy-farmer on the Tauranga side of Patatere Plateau obtained decided results on his herd with the material used with salt, both in the bails mixed with food and as a lick in the paddocks (see this *Journal* for April, 1929, page 233, and 1929 Annual Report of Department of Agriculture, page 48). The matter was reported in the Ninth and Tenth Reports to the Empire Marketing Board for the quarters ending June and September, 1930, as follows:—

Iron Licks for Supply of Food Iron.

Generally speaking, much better progress is now being made with the carbonate of iron as a lick than hitherto has been the case. Quite a number of more reliable farmers have been supplied with this compound, and nearly all report some good results from its use. In most cases molasses had to be mixed with the salt and iron in the first instance to induce the animals to take the lick, but once accustomed to it the molasses was gradually reduced until only the salt and carbonate remained.

A very extensive experiment with sheep on iron-lick treatment is being conducted on 1,600 sheep. The mortality in the flock due to bush sickness has been considerably below that of previous years, whilst the general condition of the sheep leaves little to be desired. More definite results will be available for the December report. With cattle in another district a reliable settler reports having had excellent results over two seasons with carbonate of iron and has used no citrate of iron during all that time, notwithstanding which his stock are all in perfect condition.

Lick and Pellet Feeding of Sheep at Atiamuri, Rotorua District.

Experiments were originally commenced on this farm in January, 1930. After some initial trouble in inducing the sheep to take the pellets (which had been made rather too hard), six ewes and five lambs, the latter showing signs of bush sickness, commenced taking them regularly. After three months they had improved so as to be in exceptionally good condition. It was stated that these were the first lambs ever reared on this farm (which is devoted principally to sheep-farming) to the hogget stage. On account of sickening rapidly after weaning, it is the practice to sell them on the mothers. In May thirty Romney ewes (four- to six-tooth) and twenty English Leicesters of the same age and sex were selected for further trial. These sheep had been on the property two or three years, and were a very

fair average of what sheep become when held in this locality for any length of time. Although not decidedly sick, they were not thriving. Experience had shown that healthy lambs could not be obtained or reared from ewes in this condition.

The extensive experiment at Rotorua on land bush-sick for sheep, in which 1,600 sheep are being used, still continues to make good progress. Mr. C. R. Taylor, Country Assistant in charge of the experiments, reports under date of 28th October that the manager of the run is quite elated by the results so far obtained of feeding out carbonate of iron to his sheep this winter. He says that without a doubt the flock is in a much better condition (from the bush-sickness point of view) than he has ever seen it at this season.

It is further interesting to note that sheep in the control mob are becoming sick, many being in an advanced stage, whilst the pellet and carbonate-lick mobs are making fair progress in spite of the abnormal spring experienced this year and consequent shortage of food.

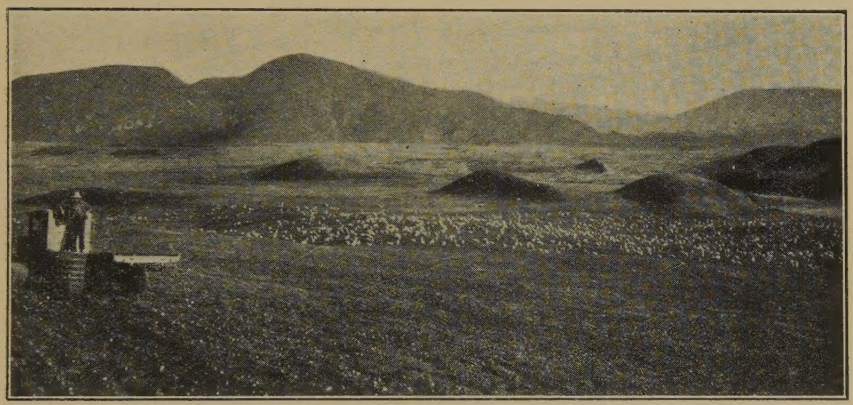


FIG. 1. FLOCK OF 1,600 SHEEP AT ATIAMURI, FEEDING ON TURNIPS, WITH ACCESS TO CARBONATE OF IRON AND SALT LICK.

The results of the preliminary Atiamuri experiments recently concluded may here briefly be described. On this sheep-run it had never before been possible to raise lambs to maturity without treatment. The 1,600 ewes were allowed full access to some carbonate-of-iron lick from May, 1930, to November (see Fig. 1). Forty other ewes were selected as controls, and these had no access to the lick. On 14th November, when the controls were shorn, their average weight was 96·41 lb. On the other hand, the weight of twelve sheep taken at random from the 1,600 ewes was 119 lb. Mr. Taylor reported on 10th March last that the forty control sheep, with their lambs, had completely gone to pieces, only eleven surviving; and that three others would probably have died, but in order to save unnecessary loss to the owners they were drenched with a solution of iron ammonium citrate and put on a slagged paddock, where their response to the iron treatment was immediate. The 1,600 ewes, on the other hand, survived in good healthy condition and the majority raised their lambs successfully.

The efficacy of the iron carbonate mixed with salt as a lick for sheep has so impressed itself on the minds of the owners that they have purchased a ton of the iron carbonate and ordered another ton. As to the quantity required, it may be said that on this sheep-station 2,000 sheep consumed only 16 cwt. of the carbonate in eight months (June to January), or less than 1 lb. per sheep, at a cost of ¾d. each.

Composition of the Carbonate of Iron.

Some details of the composition and fineness of the carbonate of iron prepared as previously described may be given. The sample was all fine enough to pass a 100-mesh sieve (10,000 meshes to the square inch). Chemical analysis showed the composition to be as follows:—

Analysis of Huntly Spathic Iron, 18th July, 1929.

	Per Cent.
Silica crude, SiO_2	20·03
Silica pure, SiO_2	(17·85)
Iron oxide, Fe_2O_3	36·31
Alumina, Al_2O_3	12·45
Lime, CaO	5·85
Magnesia, MgO	0·99
Phosphoric acid, P_2O_5	4·00
Carbonic acid, CO_2	20·71
Potash, K_2O	Trace.
Sulphur tri-oxide, SO_3	Absent.
Manganese, Mn	Trace.
	100·34

36·31 per cent. Fe_2O_3 — 25·39 per cent. Fe — 52·68 per cent. $FeCO_3$ (iron carbonate). 20·71 per cent. CO_2 — 54·53 per cent. $FeCO_3$. Difference: $FeCO_3$ undetermined in crude silica — 1·85 per cent. Moisture not determined.

This sample compared favourably in price with that at which Spanish spathic ore could be imported into New Zealand, as quotations obtained by the High Commissioner in London have shown. A partial analysis of another sample made in March, 1930, shows it to contain 26·96 per cent. Fe compared with 25·39 per cent. in the sample analysed above, and 92·35 per cent. of this passed a 120-mesh sieve (14,400 meshes to the square inch). The material that is now being supplied in the treatment of bush sickness is therefore an extremely floury powder, and when mixed with salt in equal weights the carbonate, which when fresh is of a grey colour, partly oxidizes to a brownish colour.

Pellet Trial with Sheep.

At the same time as the foregoing experiments were taking place, a pellet food trial was carried out with sheep on the same country. Pellets or cubes were made by Messrs. F. Winstone and Co. of Auckland, by means of a special cubing-machine which the firm has imported for the purpose of making commercial food pellets or cubes, and capable of turning out from 8 tons a day. The composition of the mixture forming the pellets was as follows: Iron ammonium citrate, 150 lb.; coconut-meal, 240 lb.; wheatmeal, 330 lb.; lucerne-meal, 240 lb.; pea-meal, 180 lb.; cod-liver oil, 20 lb.: total, 1,160 lb.

It was found that this mixture passed through the machine quite successfully, and the resulting pellets were of such consistency that

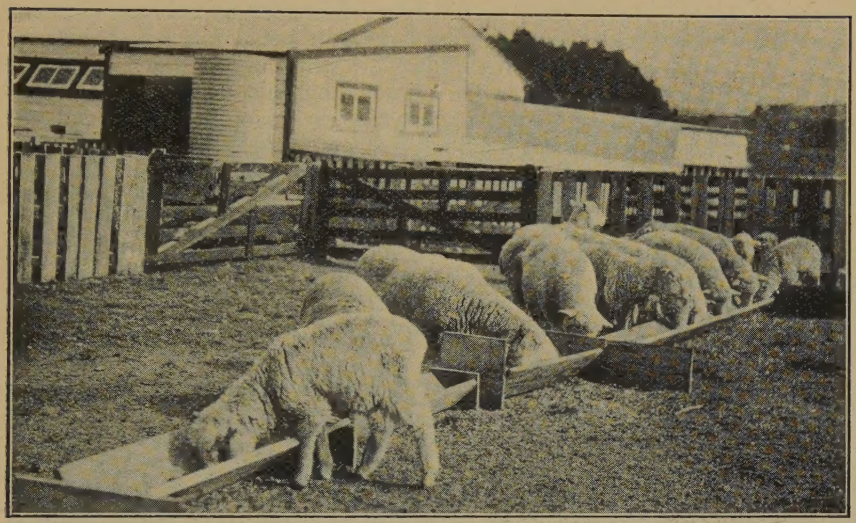


FIG. 2. EDUCATING A MIXED LOT OF SHEEP TO TAKE THE PELLETS.

The sheep in foreground is typical of those selected for pellet treatment and control. Farther back are a few rams just beginning to show signs of sickness.

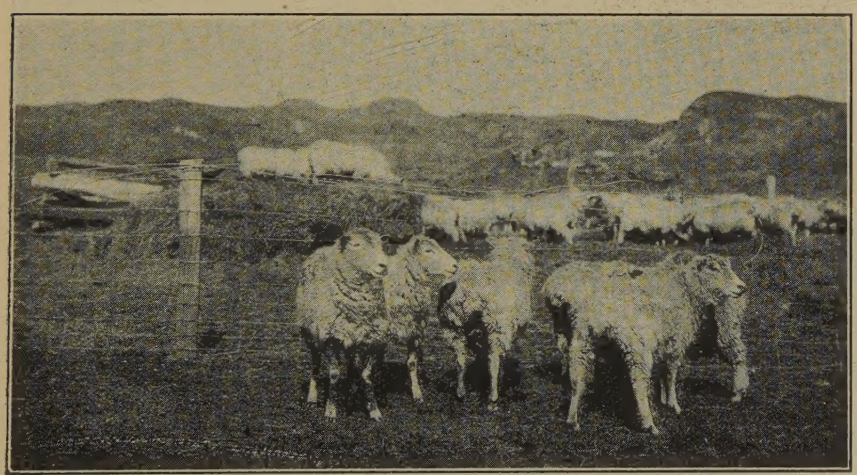


FIG. 3. SHEEP SELECTED FOR PELLET-FEEDING, BEFORE TREATMENT WAS COMMENCED.

These animals could not possibly have survived the winter without some effective treatment.

they could be bagged in ordinary corn-sacks without becoming broken to a powder, and they would keep without getting mouldy for over two years. The average weight of each pellet was from one-sixth to one-eighth of an ounce.

The pellet-treated sheep, consisting of fifty ewes, showed a wonderful response to the treatment, the difference in appearance between them and the non-pelleted sheep on the same run being most marked (see Figs. 2, 3, and 4). The writer, however, while urging that the result of the healthiness was due to the mineral ingredients, would attribute the good condition of the sheep to the extra food supplied in the nutrient meals. The initial difficulty of getting the ewes to take the pellets was, as in past experiments (see this *Journal* for January, 1929, p. 10), overcome by the starvation of some of the sheep until they would eat the pellets. The other sheep then soon learnt to follow the example set them by the sheep which had learnt to eat the pellets. This method of feeding concentrates to sheep has much to commend it compared with feeding the material as a meal. When the pellets

FIG. 4. SOME OF THE PELLET-FED SHEEP AFTER THREE MONTHS' TREATMENT.
Note the wonderfully improved condition, the length of wool, and the healthy well-grown lamb.

are thrown on to the ground they are at once greedily eaten by the sheep and, if properly distributed, each sheep gets its fair share when averaged over a number of days.

The feeding of a more highly concentrated pellet made with meat-meal would probably effect just as spectacular results as a pellet made from vegetable meals. The writer would, however, suggest that in turning the sheep into a partly carnivorous animal the composition of the pellet should be such as a carnivore, which is accustomed to drink the blood (containing much salt and iron) and to eat the bones (much lime and phosphate), would appreciate. In other words, the pellet composition should be balanced and contain assimilable mineral foods as well as protein that is a heat- and energy-producing food.

These pellet-fed sheep were selected from the poorest-conditioned animals on the farm, and were so low in condition that they could not, in the opinion of the manager, have survived the winter without some

FIG. 5. SOME OF THE RAMS THAT HAD PREVIOUSLY SHOWN SIGNS OF SICKNESS IN EXCELLENT CONDITION AFTER THREE MONTHS' TREATMENT WITH PELLETS.

FIG. 6. PELLET-FED RAMS SHOWING SPLENDID CONDITION AFTER THREE MONTHS' TREATMENT.

A few of the sick ones in the flock were picked out for this trial.

special treatment. When shorn in November they had so far improved that the average shorn weight was 99 lb. There was no control group to compare with this lot of sheep, but a rough comparison was obtained

from some sheep which were in a better condition at the beginning of the experiment and, not getting pellets, at shearing weighed only 96½ lb.

In addition to the ewes, a number of rams on the farm were also treated with pellets, the result being that, while as a rule it was usual to lose a large proportion of rams from bush sickness (nine out of twenty-two last year), this year none so far has succumbed. Figs. 5 and 6 show the excellent condition of the rams which took the pellets.

Experiments with Iron Carbonate in Ensilage.

Some experiments have been made using the carbonate of iron mixed with salt in ensilage and in haymaking. The matter is referred to in our report to the Empire Marketing Board for the quarter ended 30th September, 1930, as follows :—

> During last autumn a stack of ensilage was built in the Kaharoa district from good aftermath (principally red clover), with the incorporation of approximately 1 per cent. of a mixture of equal parts common salt and carbonate of iron. This material was spread in layers during the building of the stack, and on the latter being opened in the spring appeared as dark bands about 6 in. apart. Some calves in poor condition improved wonderfully when fed with the ensilage, which was of good quality apart from the added iron. Untreated ensilage, however, does not affect a cure in bush sickness.
>
> An analysis was made of a sample of the ensilage as a whole . . . In addition, water extracts of the light and dark bands were analysed to determine to what extent, if any, the iron had been made soluble by its incorporation in the ensilage. Where there was evidence of the added iron being present in the ensilage, the water-soluble iron calculated on the moist material was present in amount five times greater than in that portion of ensilage which contained no added iron. It thus appears that a small amount of the carbonate of iron has been rendered soluble by the organic acids in the ensilage and by the salt. In this condition it would probably be much more readily assimilated than in the original insoluble condition.
>
> Arrangements are in train for an extension of experiments on a large scale with the treatment of ensilage and hay with the native iron carbonate (spathic iron-ore) in a finely ground condition. Subsequently the hay and ensilage will be fed to stock to determine whether an automatic method of administering food iron can be demonstrated successfully to the farmers' satisfaction.

The iron carbonate is giving encouraging results mixed with milk in the feeding of calves, while the dairy herd fed on the treated silage show a marked increase in butterfat production. With regard to the general use of carbonate of iron and salt mixture, two farmers in a slightly bush-sick area reported very favourably on it after some years experience. One man's cows are in splendid condition and he is quite confident of its value. Another farmer on the worst type of bush-sick country has been feeding it with great success to his dairy herd. This season he has not been troubled with a single sick beast, and in April last all looked so well that the wintering of them was causing little anxiety.

Another remarkable fact on this place is that two pet lambs since weaning have been taking the lick and doing splendidly. This seems to point the way to the use of sheep permanently on this type of soil, which hitherto has been deemed to be an impossible task.

ECONOMIC POSITION OF THE DAIRY INDUSTRY.*

A BRIEF SURVEY OF PRESENT CONDITIONS.

E. J. FAWCETT, M.A., Farm Economist, Department of Agriculture, Wellington.

THE average pay-out received by farmers for butterfat supplied during the current season represents a substantial reduction compared with the average of the past eight years. From 1922–23 to 1929–30 inclusive the price has fluctuated between 15d. and 19d. per pound, with an average for all butterfat produced in the Dominion of 17d. over the whole period. An anticipated pay-out of 11d. for 1930–31 therefore represents a reduction of 6d. per pound, which entirely upsets the economic structure of the industry as built up on the prices ruling during the last decade.

Total production for the season 1929–30 represented 314,068,158 lb. of butterfat, 280,680,587 lb. of which was converted into butter or cheese, while approximately 20,000,000 lb. was consumed as milk or cream, or manufactured as other dairy-products. Therefore, to obtain a rapid idea of the position, assuming that a similar amount of butterfat will be produced this season and that milk and cream realize a butterfat price only, we find that, had the average price of the past eight seasons been obtained, the gross income represented by milk on a butterfat basis would have been £21,250,000, whereas actually it will not exceed £13,750,000. In addition, pig products and cull dairy stock represent an annual gross income of approximately £1,250,000, which automatically raises the above figures, but the difference is maintained. The dairy-farmers of New Zealand will receive £7,000,000 less from dairy factories than would have been the case had prices been maintained at the level on which the industry has been capitalized.

ALLOCATION OF FARMER'S INCOME.

The farmer's gross income is absorbed through three channels: (1) Expenditure on the farm itself, aiming at maintaining or increasing production; (2) payments on capital represented by mortgages on land, stock, chattels, &c., or on overdrafts; (3) personal expenditure of the farmer and his family, whether on necessities or luxuries, this portion being either labour reward of the owner and family plus hired labour, or interest on the farmer's equity. It is difficult to allocate the gross income to its respective items, as indebtedness represented by borrowed money is not known. It is estimated that normally the position would be approximately as follows:—

	£
(1) Farm maintenance (excluding all interest and wages or labour reward)	6,000,000
(2) Interest on borrowed money and farmer's equity	9,000,000
(3) Wages and labour reward	7,500,000

* This article is based on the evidence given by the writer before the Industrial Arbitration Court, at Wellington, last month, in connection with proceedings under Part II of the Finance Act, 1931.

The Capital Position.

If the foregoing figures are accepted as reasonably correct, what must be the position with a gross income which has depreciated by £7,500,000? If we assume for the time being that 50 per cent. of the total capital credited to the industry represents farmer's equity, and that £6,000,000 is the minimum required to maintain production at its present level, we find that the labour income (whether owner's reward or paid wages) must be reduced to £4,500,000, and interest on farmer's equity entirely dispensed with. Thus, whereas dairy-farmers would have received £12,000,000 as interest or for wages and labour reward, their income to meet the same items will this season be in the vicinity of £4,500,000.

Undoubtedly the item of farm maintenance has been reduced in an endeavour to meet interest payments and to maintain a certain standard of living, but it must be recognized that any serious curtailment of this item would result in disaster if persistently practised. The three major expenses are fertilizers, rates, and power, representing approximately 35, 17, and 11 per cent. respectively. Other costs include cartage, seed, oil, rubbers, general repairs to milking-plant and other machinery, cow-covers, herd-testing, medicines and veterinary appliances, licks and concentrated foods, telephone, insurance on farm buildings and hired labour, fencing material for repairs or subdivision, repairs to buildings, and cement, gravel, sand, &c.

Some of these expenses can be curtailed temporarily without affecting production, but the saving is comparatively small. Power and rates cannot be reduced, and therefore the item which is most likely to be materially affected is that of fertilizers. Every analysis of production figures made clearly indicates the close correlation of fertilizers and production, leaving no doubt whatever that a reduction in manure utilization must result in decreased production and an increased maintenance cost per pound of butterfat. Such a movement eventually means a decreased net return to the farmer, decreased trading-power to the country, and a depreciated security to mortgagees.

In view of the immediate position created by low prices for dairy-produce, and the generally accepted advice that there is no prospect of a return to prices approaching those ruling during the past decade, a more detailed study of the economic state of the industry is warranted, as it affects not only the farmer, but private mortgagees, lending institutions, and the State generally.

It is estimated that the area actually devoted to dairying in the Dominion is approximately 4,000,000 acres, carrying £30,000,000 worth of stock and plant. On the basis of 1929–30 production, and at 17d. per pound for butterfat, plus an additional 1d. per pound for pig products and sales of stock, this area, we have seen, was capable of paying reasonable maintenance costs—£7,500,000 for labour, and 6 per cent. interest on a total capital of £150,000,000, which latter is a conservative estimate of the assumed capital represented in dairy-farms, stock, and equipment.

The position can be briefly summarized as follows:—

(1) With a pay-out of 17d. per pound, and a total production equal to that of 1929–30, the industry could meet adequate maintenance

expenses, pay £100 for every male labour-unit or its equivalent, and meet interest charges at 6 per cent. on a total capital of £170,218,654, all farms being able to contribute to the gross interest bill.

(2) With a pay-out of 12d. per pound, and under the same conditions of production, maintenance, and labour, 86·71 per cent. of the total farms, producing 46·9 lb. of butterfat per acre or better, could contribute to the interest bill, but the total surplus available represents 6 per cent. on £59,148,284 only.

(3) With a pay-out of 11d. per pound, and under the same conditions of production, maintenance, and labour, 75·90 per cent. of the total farms, producing 61·4 lb. of butterfat per acre or better, could contribute to the interest bill, but the total surplus available represents 6 per cent. on £36,934,501 only.

(4) With a pay-out of 10d. per pound, and under the same conditions of production, maintenance, and labour, 60·77 per cent. of the total farms, producing 77·9 lb. of butterfat per acre or better, could contribute to the interest bill, but the total surplus available represents 6 per cent. on £14,715,274 only.

In other words, under a fixed maintenance and labour bill, every movement of 1d. in pay-out for butterfat represents a movement in interest surplus of £1,332,000, or equal to 6 per cent. on a capital of £22,200,000.

With a static cost for maintenance commodities the effective method of reducing costs is to increase production per unit of area farmed, and this may be expressed by saying that, with a pay-out of 12d. per pound for butterfat, an increase in the average production standard from 80 lb. to 100 lb. per acre would provide an additional income of £2,139,682 above maintenance and standardized labour costs, or an amount equal to 6 per cent. on an additional £35,661,372 capital.

A Ready Guide in studying Management Efficiency.

For the guidance of all concerned it is desirable that a rapid method of gauging the production standard and interest capacity of any farm be available. There are certain points in dairy-farm management which represent controlling factors in production, and which should be considered where studying the farmer's ability to pay interest on capital represented by his farm and stock. These features can be summarized as follows:—

(1) Ability to carry a large number of milking-cows per given area is usually more apparent on small farms, although many instances of heavy capacity are found on comparatively large farms.

(2) Heavy carrying-capacity is usually associated with high per-cow production, but exceptions will be found where understocking is practised for the purpose of obtaining high records.

(3) Heavy per-acre production is closely associated with economic units of area combined with high carrying-capacity of milking-cows, as these two factors are connected with high average cow production.

It is generally accepted by individuals and organizations that the average production per acre of dairy land in New Zealand is very high, particularly in some North Island districts, where a fair proportion of farm records substantiate this assumption. Such records are given prominence, and have led to a misunderstanding of the real

position. There are instances of extremely high production per acre, but it is estimated on very reliable data that only about 1·55 per cent. of the total farms devoted to dairying produce 180 lb. per acre or over, representing about 36,000 acres. About 8·8 per cent. of the farms produce from 140 lb. to 180 lb., and account for approximately 222,500 acres. Farms producing from 100 lb. to 140 lb. represent just over 28 per cent. of the total, and account for approximately 838,000 acres. About 35·5 per cent. produce between 60 lb. and 100 lb., and account for more than 1,543,000 acres; while approximately 25 per cent. of the farms produce less than 60 lb. per acre, and account for 1,360,000 acres. Approximately 70 per cent. of the farms produce between 40 lb. and 120 lb. of butterfat per acre, and account for over 2,800,000 acres of the total 4,000,000 estimated as being devoted to dairy cows, the average production over all amounting to 80 lb. per acre only.

It will be appreciated, therefore, that production is a variable factor which has a wide range of possibility, and this becomes of greater moment when it is realized that maintenance costs per pound of butterfat vary inversely with per-acre production. The fact that labour efficiency depreciates with reduced per-acre production has an effect on labour costs which is equally serious. These two factors have an accelerating tendency as production drops down the scale of efficiency, which outweighs the drop in accredited land-values. Thus the farmer in considering a dairying proposition must take these factors into account if trouble is to be avoided in the event of produce-price variations.

Range and Variation in Factors controlling Production per Acre.

As a guide to the operation of factors previously discussed, the following tables, based on an analysis of 1,654 farms, should prove of some use. It must be understood that many instances will be found which do not conform to these standards, but so long as any individual instance studied shows a better position than illustrated, it is an advantage. If worse than illustrated, the person or organization studying the farm can draw conclusions which should be of value.

Table 1.—Range of Factors which control Farm Stability.

Butterfat per Acre.	Cows Milked per 100 Acres.	Butterfat Average per Cow.	Size of Farm.
lb.	Number.	lb.	Acres.
180 and over.. ..	62 and over	300	76
160–180	57–61	290	80
140–160	52–56	280	84
120–140	47–51	266	90
100–120	42–46	250	102
80–100	37–41	233	120
60–80	31–36	213	144
40–60	22–30	192	176

It should be noted that as production per acre drops, the range in carrying-capacity likely to be associated with any production group tends to widen, and it must be remembered that variation in either cows carried or butterfat per cow may produce a satisfactory per-acre production provided there is a compensating or cumulative variation in the opposite factor. For instance, 100 lb. to 120 lb. per acre may be produced with cows averaging 220 lb. provided more cows are carried; or where 42–46 cows are carried, a high per-cow average may raise per-acre production beyond the 100–120 lb. group.

Influence of Production on Costs.

Having established the production group into which any farm falls, it is necessary to consider the effect of such production on costs. To do this it is first essential that a total labour reward be assessed. In the following table £100 per annum per male unit employed has been taken, whether it be the owner or hired labour, and the cost per pound is then based on labour efficiency. For instance, it is found that whereas one male unit can on the average produce 5,500 lb. of butterfat on a farm of 160–180 lb. per acre production, the same unit can only produce 4,500 lb. on farms of 100–120 lb. per acre production. In other words, the greater area required per cow and the consequent management demanded tends to dissipate labour efficiency; and if we assume that a minimum labour reward is required per unit for living purposes, irrespective of production, a heavier labour cost per pound of butterfat must follow. On farms producing 10,000 lb. or more it may be possible to reduce labour reward, but on the smaller family farm the labour reward quoted per pound of butterfat represents a reasonable minimum below which the living of the family must be seriously affected.

Table 2.—Labour and other Costs per Pound of Butterfat produced, allowing £100 per Annum per Male Unit of Labour.

Butterfat per Acre.	Maintenance.	Labour.	Total.	Labour Efficiency per Male Unit.
lb.	d.	d.	d.	lb.
180–200	3·0	4·11	7·11	5,833
160–180	3·2	4·36	7·56	5,500
140–160	3·4	4·65	8·05	5,167
120–140	3·7	4·97	8·67	4,833
100–120	4·1	5·33	9·43	4,500
80–100	4·6	5·76	10·36	4,167
60–80	5·2	6·26	11·46	3,833
40–60	5·9	6·86	12·76	3,500

Having decided that the balance of management factors is reasonably accurate by the resultant production per acre procured, it is then expedient to array the farm costs against those provided above. Again it may be found that individual figures do not conform precisely with this table, but there should not be great variation from it. The term "maintenance" is used to cover all items other than

interest, rent, and labour, and includes manure, rates and taxes, power, cartage, repairs, and general farm expenses. In considering the point at which any farm can pay interest on the basis of Table 2, and for any particular pay-out for butterfat, attention must be given to supplementary returns from pigs and dairy stock. It is estimated that on the average dairy-farm where pigs are kept and cull cows and "bobby" calves sold the average return from these sources is at least 1d. per pound over all butterfat produced. Farms supplying cheese-factories may not average this amount, and where misfortune has been experienced through disease and heavy replacement, necessitating buying, a loss may be made on the stock account.

Interest Capacity of Farms as influenced by Production.

Table 3 is given as an illustration of the manner in which the data contained in previous tables can be utilized to arrive at the interest-earning capacity of any farm, accepting the costs, &c., given as a basis of computation. The final figure, given as capital per acre, represents total capital of farm, improvements, stock, and plant. The two latter items average approximately £7 per acre, varying according to density of stock, their accredited value, and the size of farm.

Table 3.—Total Average Income per Farm on the Basis of 1s. per Pound for Butterfat according to Butterfat Production per Acre, and its Allocation, allowing £100 per Annum per Male Unit of Labour.

Butterfat per Acre.	Average Area of Farms.	Total Average Income.	Total Maintenance Costs.	Total Labour Reward.	Interest Surplus.	Capital per Acre represented.
lb.	Acres.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
180–200 ..	78	802 15 0	185 5 0	253 15 10	363 14 2	77 14 4
160–180 ..	80	736 13 4	181 6 8	247 1 4	308 5 4	64 4 5
140–160 ..	84	682 10 0	178 10 0	244 2 6	259 17 6	51 11 3
120–140 ..	90	633 15 0	180 7 6	242 5 9	211 1 8	39 1 10
100–120 ..	102	607 15 0	191 13 6	249 3 6	166 18 0	27 5 5
80–100 ..	120	585 0 0	207 0 0	259 4 0	118 16 0	16 10 0
60–80 ..	144	546 0 0	218 8 0	262 18 5	64 13 7	7 9 9
40–60 ..	176	476 13 4	216 6 8	251 10 8	8 16 0	0 16 8
20–40 ..	214	347 15 0	181 18 0	202 15 3	— 36 18 3	—2 17 6

Note.—One penny has been added per pound of butterfat, as the average return from pig products, &c.

As an example, we can assume a farm of 100 acres producing 110 lb. of butterfat per acre.

	£ s. d.
Butterfat produced, 11,000 lb. at 1s. =	550 0 0
Pig products, &c., at 1d. per pound of butterfat =	45 16 8
Gross income	595 16 8
£ s. d.	
Maintenance expenses at 4·1d. per pound 187 18 4	
Labour at 5·33d. per pound = 244 5 10	
	432 4 2
Interest surplus	163 12 6

		£	s.	d.	
Total capital on which £163 12s. 6d. will pay interest at 6 per cent.	=	2,727	0	0	(approx.)
Capital per acre	=	27	5	5	
Less £7 per acre for stock and plant, leaves capital value land and improvements	=	20	5	5	

SUMMARY.

(1) The capital position of the dairy industry has been rendered unstable (at least temporarily) by the acute drop in the prices of produce.

(2) In an attempt to meet their capital liabilities farmers are forced to reduce their living expenses, and in many cases the costs of maintenance and working have also been reduced. As fertilizers represent the only cost item of great moment which is within the discretion of farmers, it is natural that this should be curtailed.

(3) As fertilizers represent the greatest single factor in maintaining or increasing production and lowering the unit cost, a curtailment of their use at the present time is unsound from every viewpoint.

(4) Production of butterfat per acre is the measurement of efficiency in management. Whereas the average for all dairying land is now in the vicinity of 80 lb. per acre, it is possible to raise this to 100 lb. by concerted effort and adoption of the best methods known. A similar increase has been obtained during the past four or five years, and there is still very great scope for improvement, particularly in the large aggregate area of land comprising the average or below-average farms.

The methods which should be adopted to this end are:—

(*a*) Adequate top-dressing of pastures, particularly in the autumn, thus ensuring a plentiful food-supply in the following season.

(*b*) Exploitation of produced feed, aiming at a balancing of stock to total grass. This entails preservation of surplus grass during the rapid-growing period, preferably in the form of silage.

(*c*) Having ensured the winter food-supply, every endeavour should be made to build up the effective milking herd, as per-acre production can be more rapidly influenced by the number of cows milked than by increased production per cow. The great obstacle in the way of a rapid increase in effective milking-cows is the replacement requirement consequent upon disease in the herd. Approximately forty head of young stock must be carried to every hundred milking-cows, and this automatically reduces the pasturage available for milk-production. It is impossible to overstress this fact, for a better realization of the disadvantages imposed through heavy replacement would cause farmers and interested organizations to consider every possible channel through which its effect might be minimized.

(*d*) In conjunction with improved exploitation of pastures, the improvement in herd averages tends toward maximum per-acre production. As high-producing cows gradually assume a greater proportion of the total herd an acceleration in average increase is to be expected, as replacement stock will be of a higher calibre. Herd-testing then assumes the importance which it deserves, and must play an important part in the final analysis of factors contributing to high per-acre production.

(7) In the final consideration of a farmer's position, it should be remembered that his homestead and farm perquisites represent a sum of approximately £100 per annum when compared with city conditions. This fact enables a family to exist on a farm with a comparatively small labour reward in cash. The amount represented by these items depends upon the capital value of the homestead, or what a similar house could be rented for in towns.

Conclusion.

In conclusion, the fact may be again stressed that the future of the dairy industry is of paramount importance to farmers, investors, the State, and local bodies, as the dairy-farmer depends on the industry's prosperity for his livelihood, the investor for the security of his investment, the State for trading-power essential to meet loan commitments and public utilities, and local bodies as security for loans expended on transport and other facilities. The efforts toward re-establishment of prosperity therefore demand concerted action on the part of all concerned, and must be viewed as a national endeavour.

THE WHEAT RESEARCH INSTITUTE.

SOME SALIENT FEATURES OF ITS WORK.

The New Zealand Wheat Research Institute has issued its first annual report, a pamphlet of some sixty pages. About half of this space is occupied with a general description of the results obtained over all the field in which the Institute works, and the remaining pages are occupied by two technical articles—one on the correlation of protein in wheat with the quality of the resultant loaf, by Mr. H. E. West, Chemist to the Institute, and the other on analytical yield investigations by Dr. O. H. Frankel, Plant Geneticist. The report proper is divided into four sections: (1) History and organization; (2) wheat-breeding; (3) milling and baking tests; (4) economic investigations. Some of the salient points in each of the sections are here recorded.

History and Organization.

The object of the Institute is to improve the wheat, flour, and bread of New Zealand. It is supported by levies of three half-pence per ton of wheat or flour sold by farmers or made by millers or bought by bakers, and the union of these three interests is one of the most striking instances on record of industrial organization for scientific research. The staff of the Institute, of which Dr. F. W. Hilgendorf is Director, consists of a research chemist, a geneticist or plant-breeder, a baker, and three laboratory assistants. The plant-breeding station is at Lincoln Agricultural College, and the chemical laboratory, with its milling and baking plant, at Canterbury College, Christchurch. The Institute has been in work for just over two years.

Wheat-breeding.

The plots at Lincoln occupy a field of 24 acres, part of which is cropped and part fallowed each year. Yield trials of standard varieties in competition with new introductions of some promise are made each year, and the wheats from the plots are milled and baked to test their true value. Following are the results to date :—

Table 1.—Yield Trials, Baking Trials, Milling Yields, and Protein Contents of Common Wheats.

Variety.	Yield.		Baking Score.		Milling Yield.		Protein Contents.	
	Bushels per Acre. (1)	Years of Trial.	Loaf Value (40 = Very Good). (2)	Number of Trials.	Per Cent. of Flour. (3)	Number of Trials.	Per Cent. Protein. (4)	Number of Trials.
Solid-straw Velvet	55·2	4	31·7	7	73·1	7	9·5	13
Solid-straw Tuscan	54·9	6	31·3	49	69·0	46	9·8	341
Victor	54·7	1	24·0	2	70·5	2	8·4	11
Dreadnought ..	51·9	1	31·5	9	72·4	8	9·6	17
Major	51·7	7	28·0	7	68·9	7	8·8	10
Hunters	50·6	7	35·0	12	70·1	10	9·51	111
Velvet	49·0	5	32·4	13	74·5	13	9·70	66
Red Fife ..	46·9	6	33·7	10	..	..	9·5	9
Marquis	46·9	7	35·9	16	70·9	15	9·9	22
1/79/13	46·6	2	34·0	2	67·5	4	9·5	4
1/76/6	45·8	2	36·0	2	70·9	2	10·2	2
Yeoman II ..	42·3	4	35·3	8	74·4	8	9·4	13
Goldberry ..	..	..	28·6	3	72·3	3	9·9	4
Garnet	..	..	37·1	11	69·2	11	11·1	16
Jumbuck ..	..	..	30·0	2	77·5	1	10·0	10

Notes.—(1) The figures allow the following conclusion : In the years covered by the trials on good wheat-growing land, Solid-straw Velvet and Solid-straw Tuscan were high yielders ; Major, Hunters, and Velvet were medium yielders ; Red Fife, Marquis, and Yeoman II were low yielders. The other varieties have not been sufficiently tried for any conclusions to be drawn.

(2) (*a*) In the two years of trial Garnet, Hunters, Marquis, and Yeoman II produced loaves above the average quality ; (*b*) Solid-straw Tuscan, Dreadnought, Velvet, Red Fife, and possibly Solid-straw Velvet produced loaves below the average quality ; (*c*) Major has probably a low baking quality.

(3) The milling yields refer to the experimental mill used at the laboratory. They do not necessarily reflect the yield of flour obtainable on a commercial mill, though the high yield of Velvet and the low yield of Tuscan are quite in accord with commercial experience.

The table shows that none of the wheats at present grown combines a high yield per acre, a high percentage of flour extraction, and a high baking score. To find such a wheat is an objective of the Wheat Research Institute.

The present advice is to keep to Tuscan, Hunters, and Velvet. Each of them has qualities of yield, or straw, or milling extraction, or baking quality that makes it sure of acceptance. New varieties

should be grown by farmers only after trial by the Institute, which can more easily bear the loss caused by failures than individual farmers can.

The ordinary half-drill strip method by which these trials are made occupies a great deal of space, and so in conjunction with them hand-sown chessboards have been used to see if reliable results can be obtained on smaller areas. These plots are sown by hand, they occupy only one-hundredth part of the area, and take little more time in sowing and harvesting, and the important result has been obtained that by using refined methods the chessboard places wheats in the same order of merit as the half-drill plots do. This enables an expansion of the work without any expansion of area.

One of the plans for improvement is to cross the high-yielding wheats of New Zealand with high-quality wheats from other lands. Wheats are gathered from every country where wheat is grown, one of the chief aims being to ascertain if any of them are suitable as parents for crossing with Tuscan. Last year 1,200 different kinds of wheat were grown for this purpose.

One of the crosses made by Lincoln College before the Institute started work is giving good promise. It is a cross Tuscan by White Fife, one of the highest-quality Canadian wheats. This cross appears from its trials so far made to be equal to Tuscan in growth characters and yield, and to be superior to Tuscan in yield of flour and in baking quality. Many more trials will have to be made before this cross is recommended for general use, but the present promise is encouraging.

The trials of the progeny of these and other crosses involve a very great amount of work. Last year there were about five thousand plots on the experimental field, and in the coming season provision is being made for twice that number.

In conjunction with the Department of Agriculture the Institute conducts a seed-wheat certification scheme. Last year about 15,000 bushels of seed wheat were certified by and sold through the Institute.

Milling and Baking Tests.

The objects of the laboratory work are broadly—

(1) To find if there is a correlation between any easily measured factor, such as protein, and baking quality :

(2) To find the baking qualities of wheats of different varieties, localities, manurings, methods of harvesting, and storing :

(3) Especially to find the baking quality of new wheats imported or bred by the plant-breeding station :

(4) To test the quality of flours produced by millers from their commercial blends. This is done by baking flours under standard conditions :

(5) To help millers and merchants in preparation of stock-foods containing wheat and wheat by-products :

(6) To guide bakers to improved methods of handling the flours at their disposal :

(7) To investigate special problems as they arise—*e.g.*, the effect of Vitamin E extracted from wheat-germ on sterility in cattle.

A summary of the work done during the calendar year 1930 will show its general scope.

Samples milled: 63 from the wheat-breeding station at Lincoln; 142 from variety and manurial trials in various parts of Canterbury; 213 from samples from farmers and millers: total, 418.

Samples baked: 63 from the wheat-breeding station at Lincoln; 142 from variety and fertilizer trials; 213 samples from farmers and millers; 150 flours from wheats milled in 1929; 850 samples of commercial flours sent in by millers for testing; 150 for trials of special baking methods; 162 to test the effect of different kinds of preserved milks added to doughs—1,730; or, since each is done in duplicate, total, 3,460.

Chemical analysis: Protein and moisture—599 simple protein samples from localities; 49 from wheat-breeding plots; 29 from samples of same wheats at different stages of maturity; 14 flours; 142 wheats from fertilizer and variety trials. Protein, moisture, and ash—56 flours from different mills. Complete analysis of stock-feeds—Moisture, ash, protein, fat, crude fibre, and carbohydrates, 40 samples. Mineral constituents of twenty-five lines of wheat.

Wheat is cleaned, tempered, and milled in such a way as to make the resultant flour as nearly equal as possible to the commercial product, and a commercial standard is always used for comparison. After any sample has been milled it is kept for a month, and then baked against a standard flour under very exact comparative conditions—the loaves rotating within an electrically heated oven with automatic time and temperature control. It was by this means that the baking scores shown in Table 1 were obtained.

The percentage of the weight of wheat recovered as flour from the different varieties of wheat is shown in the following table:—

Table 2.

Variety.	Number of Tests.	Percentage of Flour.
Velvet	13	74·5
Marquis	15	70·9
Hunters	10	70·1
Garnet	11	69·2
Tuscan	46	69·0

The extraction on a commercial mill varies from these figures, but the high position of Velvet and the low position of Tuscan are in accordance with commercial experience.

The average baking scores of the different wheats are also of interest.

Table 3.

Variety.	Number of Tests.	Baking Score (40 = Very good).
Garnet	11	37·1
Marquis	16	35·9
Hunters	12	35·0
Red Fife..	10	33·7
Velvet	13	32·4
Tuscan	49	31·3

In none of the varieties except Tuscan is the number of tests sufficient to be more than an indication of the real baking value.

Several tests were made over two years of the grain yield, milling-extract, and baking quality of wheat cut green and cut ripe. The 1930 trials were performed on samples gathered with great accuracy, and the results are quite reliable for the particular field and season. They show that the stage at which wheat should be cut to give the greatest yield without risk of shaking is that defined as stage C in this *Journal* for June, 1923, page 357. It is briefly as follows: The last tinge of green has disappeared from 99 per cent. of the straws just underneath the head; all the knots are still green; the grain is so firm as to make it impossible to squeeze either milk or dough out of it when pressed between the fingers, but is still soft enough to be cut with the thumb-nail. Wheat harvested in this condition (three varieties) gave an average milling extraction of 70·3 per cent., while the same crop cut two days earlier gave an extraction of 68·6 per cent. Flour from wheat cut at this stage gave loaves with an average baking score of 28·6, while the same wheats cut two days earlier obtained an average score of 23·6. Thus the stage named C, as defined above, gives the highest yield of wheat, a satisfactory yield of flour, and a high quality of loaf.

During two seasons a trial was made of stook-threshed and stack-threshed wheat, from alternate stooks in the same field. It was found that, provided the wheat was in perfect condition when it was threshed, the stook-threshed gave as much flour and as good flour as the stack-threshed, but that wheat slightly out of condition was much improved by stacking.

A great number of samples for moisture-testing are sent to the Institute by people using header harvesters, to find out if the wheat is ready to head, and further to find if it is fit for delivery when it has been paddock-dried after heading. Samples representing 200,000 bushels were tested for moisture last harvest, and the results telegraphed to the inquirers.

Samples of wheats from the Department of Agriculture's manurial plots were milled and baked, the total number of millings in this section being 142. The results showed that manuring has little effect upon baking quality, and that in any case the advisability of manuring depends on the excellent yield results obtained, rather than on any hope of improving the baking quality of the wheat.

A great deal of work was done during the year on the effect of adding different preserved milks to the dough in bread-baking. This is a very common practice especially in the towns where high-quality bread is aimed at, and the best preparation of milk to use is a question of great importance to every baker. Among the dried skim-milks was one whose effects were somewhat irregular though they were sometimes very good. The method of preparation was investigated, and it was suggested that the temperature to which the milk was pre-heated before the actual drying had an effect upon its use in bread-making. Samples were therefore obtained which had been pre-heated to various temperatures and held there for varying times. It was found that the milks held at about 200° F. for an hour gave much

the best results, and this procedure has now been adopted by one of the largest factories in New Zealand, with the result that its dried skim-milk is giving a uniformly improved loaf.

Economic Investigations.

Header Harvesters.

The economic investigations of the Institute have chiefly been concerned with the new method of harvesting with headers, by which the wheat is cut, threshed, and bagged in one operation. A comparison was made between the climate of Canterbury and the Great Plains of America (U.S.A.), where header harvesters have recently sprung into the greatest favour, and the following table shows that in all respects the climate of Canterbury is quite suitable for the new method of harvesting :—

Table 4.—Weather of Harvest Month.

Weather Factor.	Great Plains.	Lincoln, N.Z.
Total rain	3·1 inches	1·3 inches
Rainy days	3·6	4·7
Relative humidity ..	78 (8 a.m.)	71 (9 a.m.)
Hourly wind-travel ..	8·7 miles	4·7 miles.

The following matter is reproduced in full from the report :—

The detailed tables from which these figures are abstracted made it quite obvious that the weather at Lincoln, New Zealand, is as favourable for headers as is the average weather in the Great Plains States. It has to be remembered, however, that an average for a State may be misleading. Since each State exceeds the South Island in area it is clear that there may be wet and dry districts as there are in the South Island, and that those parts in which headers are used may be drier and calmer than are the Canterbury Plains. Still, as far as the figures go, supported by details not published here, they are evidence that harvesters are possible in New Zealand.

The varieties of wheat grown and their resistance to wind is also of importance. The American varieties of which we have experience are nearly as wind-resistant as Solid-straw Tuscan, and considerable more so than Hunters and Velvet. It would seem, therefore, as if no variety but Tuscan should be held for heading in New Zealand.

The total costs of harvesting wheat by present methods has been carefully computed, for presentation to the parliamentary committee elsewhere referred to. They amount to 33s. 6d. per acre on a 30-bushel crop, half of which is stook-threshed and half stacked. This includes interest and depreciation on horses and all implements. The running charges for a harvester and tractor, including wages, fuel, repairs, and interest and depreciation on the tractor only were estimated at 13s. 8d. per acre, though the figures were obtained only by modifying American averages and not from local experience. This amounts to a saving of over 8d. per bushel on a 30-bushel crop, but the crux of the matter is still to come—namely, the original cost of the header harvester and the charges for interest and depreciation. It is probable that the life of a header in New Zealand would be twelve years, compared with the average of fifteen years for a binder, and this figure is enough to allow any one to work out his costs for interest and depreciation, and therefore his standing charges per acre and per bushel. It is probable

that if 100 acres of wheat are cut each year, and the crop averages 30 bushels, the total costs (running-costs and standing-costs) per bushel will be about 13d. per bushel by the binder and 9d. per bushel by the header harvester, but this will vary greatly with the cost of the machine purchased, its length of life, and its repair bill.

Skill in handling crops for heading, and after heading, is one of the chief factors of success, and any one using the header should employ every safeguard to avoid loss. Wheat should not be headed when it contains more than 15·5 per cent. of moisture, and this stage cannot be reached until about ten days after the wheat is binder ripe—while every knot in the straw must be dry and shrivelled. Here again great variation will be caused by the weather, and growers wishing to make sure that their wheat is ready should apply to the Institute for airtight tins, in which they can send in samples for free testing for moisture. The sample will be tested as soon as it arrives, and the result will be telegraphed to the inquirer. After heading, care is needed to ensure that the wheat remains in good condition, and that all the moisture contained in the grain has not come to the surface at the moment it is presented to the merchant. The wheat should be stacked in the field in tiers only two sacks wide, with gaps between the tiers through which the winds may blow. The heaps should be protected above and below only, and should lie in the field for a month or six weeks. The risk of rejection of grain unfit when headed, and not field-stored in the best method, is by far the most cogent argument for going slow in the adoption of harvesters. Care and skill in these particulars will give an opportunity for a fair test of a method which will reduce an average harvesting-cost from 13d. to 9d. per bushel.

The Institute set up a committee to watch all the header harvesters at work in 1930. There were five makers, some with several designs of machines, including several with windrower attachments. Most, if not all, did efficient work, though the season was a difficult one owing to the number of scattered heads that were bent down on their straws; this necessitated cutting the stubble much shorter than would normally be the case, and machines with lifting fingers showed to advantage. There was little loss of grain during harvesting—certainly not more than with a binder. In Tuscan there was little loss from grain shaken before harvest, but there was no severe norwester to try the point properly. Very careful tallies of running-costs were taken by Dr. Weston, Farm Economist at Lincoln College, and the costs for various machines in various crops costed were as follows:—

Running-costs only—wages and keep of all men, oil and grease for tractor and header, carting sacks to the heap: no interest or depreciation or repairs. (Repairs were light, the machines being mostly new.)

	Per Bushel. d.		Per Bushel. d.
Case 1	3·1	Case 6	2·7
,, 2	3·8	,, 7	2·0
,, 3	3·3	,, 8	2·6
,, 4	2·2	,, 9	5·2
,, 5	3·3		

Average running-costs without repairs, 3·3d. per bushel. To this must be added average repair bills, and interest and depreciation. If an average is taken of the prices of all the machines used in 1930, and their life is assumed to be twelve years, and if the average crop harvested is 5,000 bushels, then the total cost of header harvesting would work out at 8·7d. per bushel.

The committee found that the following precautions should be considered when the purchasing of headers is contemplated:—

(1) All areas are not equally suitable for header harvesters—*e.g.*, on downs there may be unequal ripening, and in other areas dews may delay harvesting of grain.

(2) The number of hours per day that headers can be used will be considerably less than with binders, so that harvesting will be prolonged. The systematic use of windrowing of some crops and the heading of others will allow more hours per day to be worked.

(3) Late-sown crops ripening late in the season will postpone harvesting till the days are short and the nights dewy, so that header harvesting becomes difficult.

(4) When the weather is uncertain there is considerable danger in depending on a contractor who cannot guarantee that he will have completed previous engagements.

(5) In order to keep down overhead costs the machine used should be able to handle as many types of crops as possible, so that all the overhead will not have to be borne by the wheat crop.

(6) Items of expenditure likely to be overlooked are housing of the machine, carting of bags to heaps, and subsequent care of bags in the field.

(7) To secure a saleable line it is absolutely necessary to be sure that the wheat is in condition before heading.

Thirty-seven farmers were reported as using header harvesters in 1930, and thirty-three of them were good enough to answer, carefully and fully, questions asked as to their experience. Of the thirty-three, thirty express themselves as definitely satisfied. Out of the thirty-three lots of wheat so harvested twenty were in good milling-condition, six had parts of the lines rejected by graders, two lots were rejected entirely and sold as fowl-wheat, and in three cases the answers were indefinite. In the case of two of the partial rejections it was stated that stooked wheat was just as bad as headed wheat. Most of the farmers stacked their grain in high narrow stacks in the field for six weeks, and considered this essential. Many delivered within a week or two. The more experienced men left their wheat longer before starting heading.

The general conclusion from these answers is that, provided the wheat is thoroughly ripe before heading and provided the weather is good, a dry sample producing a saleable line is cheaply produced. If the weather is damp a saleable sample is difficult to obtain, but it may be helped into wheat condition by careful paddock-handling.

The report refers to the co-operation of the Department of Agriculture with the Institute in connection with certification of seed wheat, variety trials, manurial experiments, the supply of wheat samples, and at several other points of the work.

Intensive Grassland Utilization on Hawke's Bay Farm.—The Fields Instructor at Hastings reports the case of a Pakipaki farmer who successfully harvested two crops off a 26-acre paddock between October and January during the past season. The area was sown down in the autumn of 1930 with 2 bushels of certified perennial rye-grass and 1 bushel of barley per acre. It was consistently grazed from July until October, when the paddock was shut up, top-dressed with 2 cwt. ammoniated super and 10 cwt. lime per acre, and irrigated. A splendid growth resulted, which was cut for ensilage, commencing on 20th November. The crop yielded approximately 175 tons silage. The paddock was immediately top-dressed with 1 cwt. ammoniated super, irrigated afresh, and closed up for seed about the beginning of December. The crop was cut towards the end of January, the seed stacked, and a yield of 90 sacks of seed obtained. The aftermath came away well, and in February was carrying over eighty dairy cows, day grazing.

THE ALIEN FLORA OF NEW ZEALAND.

H. H. ALLAN, Systematic Botanist, Plant Research Station, Palmerston North.

WHEN publishing his *Manual of the New Zealand Flora* in 1906 Cheeseman expressed a hope of preparing a supplementary volume dealing with the numerous introduced species. This hope was never realized, although such a book has been a great desideratum for many years. Having waited in vain for some other botanist to publish a flora of the aliens, I have had perforce to essay the task myself. This, however, is a work of some magnitude, and in the meantime it seems well to furnish an annotated list of the species concerned. Such lists have already been published, but none are up to date, and none provide a critical estimate of the status of the species mentioned. Further, they contain a number of errors of determination, and omit several species of importance.

A glance over the lists of aliens shows how steadily these incomers have increased. In his *Flora Novae-Zelandiae* of 1855 Hooker mentioned some sixty species. In his *Handbook* of 1867 the list has grown to 168. Kirk in 1870 increased the number to 292, and in his *Students' Flora* of 1899, although it covers only the Ranunculaceae to Compositae, deals with 271. In Cheeseman's *Manual* of 1906 there are 528 recorded, the aim having been to include "all species of foreign origin known to me which appear to be thoroughly well established." Thomson, in his *The Naturalization of Plants and Animals in New Zealand*, gives an important and interesting discussion of the history of the aliens, and lists 740 species, of which he considers "over six hundred species have become more or less truly wild." In the second (1925) edition of Cheeseman's *Manual* 576 species are listed as naturalized. In 1926 Cockayne and Allan gave reasons for considering as exotic some thirty-odd species that were included in the *Manual* among the indigenous plants. In his *Vegetation of New Zealand*, 1928, Cockayne considers "the more or less fully established" species to be 514.

In the lists that I shall give in instalments in this *Journal* I have tried to include all species recorded at one time or another. The number stands at about 930—that is, about half as many as the indigenous species. But of these some 250 have no real claim to be considered naturalized, and over 300 are of such rare or local occurrence that they play little part in the flora and vegetation. Some of these, however, are of potential importance, and need watching. There remain about 350 that are of real moment, but in very diverse ways. In the list more exact figures will be given, and an attempt made to indicate the real status of each species. New records are continually being made. As I write, for instance, there comes a specimen of *Nassella* from Professor A. Wall which appears to be well-established in the Waipara river-bed. This genus of grasses has its home in Chile, and the record is a further illustration of the wide-flung sources from which our aliens are derived.

In critically studying the exotics I have found a number of instances of mistakes in identification, and curious absences of record of species that have thoroughly established themselves long since. It

thus became clear that a thorough study of the systematics of the alien flora was of considerable importance. A few instances will serve to emphasize this statement. Cheeseman records *Antholyza aethiopica* as a common garden escape near Auckland. This species certainly does escape from gardens to some extent, but the specimen in Cheeseman's herbarium so labelled, and the plants that have caused agitation of mind in North Auckland, do not belong to that species, but are *Watsonia bulbillifera*. The former has some garden value, the latter very little, and no harm would be done to horticulturists were it declared a noxious weed. Acclimatization societies have often wished to introduce Canadian Wild Rice, *Zizania aquatica*, as duck-feed. Cheeseman records this species as copiously naturalized on the Northern Wairoa River, and it has fallen into ill repute. Experience of the grass in that locality is far from favourable, so that the proposals of acclimatization societies have been frowned upon. But I find that the species actually occurring in New Zealand is Manchurian Wild Rice, *Z. latifolia*, a far-spreading and pernicious perennial. The stem-bases are used as food in China, but in New Zealand it is a pest.

We need, too, more precise information on the distribution of certain species. Cheeseman's 1925 list records Hoary Cress, *Lepidium Draba*, for Christchurch, Ashburton, and Morven Hills, Otago. We know now that this nuisance is established in several parts of the North Island, and its control is becoming a matter of moment. Australian Fireweed, *Erechtites Atkinsoniae*, and cut-leaved Psoralea, *Psoralea pinnata* (a "noxious weed") are both steadily extending their range southwards. A number of species have become established without being recorded at all. Several species of *Erica* are well established on the Volcanic Plateau. A species of *Oxylobium*, belonging to a poisonous Australian genus, perhaps "the most virulent members of the flora," is increasing in manuka country near Auckland. Several species of *Eupatorium*, a genus containing some very undesirable members, are established in different parts of the North Island. And so the story goes on.

Enough has been said to show that more intense investigation of the alien flora is much needed. I am glad to acknowledge here the great help rendered by Instructors in Agriculture and by Inspectors of Stock in keeping a vigilant eye open for unknown plants, and for sending specimens of such. With such zealous workers it should be possible to exercise a greater control over our uninvited visitors than has hitherto been possible. I have also to acknowledge the help of a number of private workers, of whom I should like to mention especially Mr. M. Hodgkins, who is subjecting the neighbourhood of Auckland to a close search.

It is still necessary, however, to reiterate the true position of this alien flora in connection with the indigenous flora. I find that even in well-informed botanical circles many still are impressed by the myth that these visitors "wipe out" the indigenous ones. Hooker himself was responsible for starting the story on its rounds, and Darwin spread it in the *Origin of Species*. Wallace made much of it, speaking of the "wonderful aggressive and colonizing power of the Scandinavian flora, as shown by the way in which it established itself in any temperate country to which it may gain access. About 150 species have

thus established themselves in New Zealand, often taking possession of large tracts of country." He gives the now classic misstatement that white clover displaces the natural species and even exterminates Phormium.

All who have studied the progress of colonization in New Zealand and the history of argicultural and pastoral development know that the truth is far otherwise. The matter has been fully dealt with by L. Cockayne in his *Vegetation of New Zealand*, and is also well discussed by Thomson. W. T. L. Travers had said in 1871: "Such, in effect, is the activity with which the introduced plants are doing their work, that I believe if every human being were at once removed from the Islands for even a limited number of years, looking at the matter from a geological point of view, the introduced would succeed in displacing the indigenous fauna and flora." Thomson remarks on this: "I have no doubt that had Travers been living to-day he would have completely reversed this judgment. The opinion of all botanists in New Zealand to-day is that when the direct or—to a large extent—the indirect influence of man is eliminated, the native vegetation can always hold its own against the introduced. Those plants which have thriven abnormally in this new country and have impressed visitors by their abundance are found in settled and cultivated districts, and belong chiefly to what are known as *weeds of cultivation*, that is, plants which have become adapted to conditions caused by the direct and indirect actions of human beings, and which only thrive where these conditions are maintained."

The New Zealand botanist is struck by the other side of the picture, the power of the "natives" to return, and the way in which so many have been able to cope with the new conditions. Considered as weeds, to mention a few, note the aggressiveness of "fern," manuka, piripiri, tauhinu, rushes, in much of the occupied land. Consider, too, the story of danthonia. Cockayne puts it strongly: "In fact it is hardly going too far to declare that were such animals removed from North Island the whole of the present 'permanent pastures' would in a hundred years, or less, be well on the road once more towards dense rain-forest!"

The fact remains that we have now in New Zealand two floras and two vegetations. And this second flora plays such an important part in our economic life that it deserves and demands the most intense study we can give to it.

Dry Scale from Cream-cooler.—A sample of dry scale from the distributing-tray of a cream-cooler at a butter-factory was recently examined by Mr. G. F. V. Morgan, Bacteriologist, Dairy Division. The sample showed a yeast count of 288,000,000 and a bacteria count of 1,100,000 per gramme. Mr. Morgan remarks: "There is a pretty generally accepted idea that this stuff is sterile. This is not the case. Previous samples examined at Wallaceville Laboratory show that it is teeming with yeasts of a more or less heat-resisting type, probably affording a considerable source of contamination. It may be pointed out that yeasts are a source of damage, and have a particularly deleterious effect on both salted and unsalted butters."

SARCOPTIC MANGE OF PIGS.

TREATMENT AND CONTROL MEASURES.

W. C. BARRY, M.R.C.V.S., District Superintendent, Live-stock Division, Wellington.

THE skin disease of pigs known as mange or scabies has recently been discovered to exist on several farms in the Manawatu district. Knowledge of its presence originated through a Meat Inspector who, on observing a peculiar condition of the skin of some pigs sent in for slaughter, forwarded material to the Veterinary Laboratory at Wallaceville for examination, with the result that the parasite which gives rise to the disease was demonstrated.

The matter was at once followed up by field officers of the Live-stock Division, and within a few days the farms from which the pigs came had been located. Cases of the disease were found to exist on those places, and control measures were at once instituted both as regards remedial treatment and prevention of further spread. Active investigation in the district revealed some other farms to be also affected, and, as there is evidence that the disease has a more extensive distribution in the Dominion, full inquiry is being pursued with the object of tracing centres of infection, and, by instituting suitable treatment and control measures, to endeavour to eradicate the disease. Towards this end the co-operation of all pig-breeders is requested, as it is by reporting any suspicious cases that farmers can assist in eliminating what might prove to be a very troublesome menace to the pig-breeding industry.

Mange is caused by the mange mite, technically known as *Sarcoptes scabiei*. The parasite is not visible to the naked eye, but on microscopic examination of scrapings taken from the skin of an affected pig it is readily seen. The mites penetrate through the upper layer of the skin and excavate burrows in which their eggs are laid.

Mange may start on any part of the body. In the early stages of the disease it is usually found on the head, around the eyes, and on the ears and nose. From these parts it spreads over the neck and shoulders, and along the back and sides, until the entire body may be involved. The most outstanding symptom is an intense itching, the pig rubbing against posts, gates, or other objects. Of course, pigs will scratch themselves because of the presence of lice on the skin, but the itching in mange is much more severe, the affected parts being frequently rubbed until they become raw. Loss of hair occurs, the affected areas appear dry and scurfy, and may be covered with brownish or dark-grey crusts. Frequently scabs are formed as the result of mechanical injury produced by rubbing. In old cases the skin becomes more or less bare, is very thickened, and wrinkling or corrugation occurs.

Young pigs suffer the most. Unthrifty condition results, with low vitality; development and fattening are retarded, and severe cases may lead to general debility and death. The latter result has actually been observed on a few farms affected.

Mange in pigs is very contagious, and is usually spread from pig to pig by contact, which readily occurs in the pens. Objects upon

which affected pigs have rubbed themselves are especially a source of transmission. Litter, &c., contaminated by affected pigs is particularly dangerous. Pigs of all breeds and ages are susceptible to mange, although, as before stated, young pigs suffer most severely. A sow presenting only slight infection will infect every member of her litter. Boars are readily infected, and some bad cases have been observed in them.

Treatment.

Treatment consists in applying to the skin a preparation which will kill the mange mites, and which by repeating the application from seven to ten days later will kill any mites which have hatched out from the eggs not destroyed in the first treatment. Treatment may be by two methods—(1) Hand-dressing, (2) dipping.

Hand-dressing.

Hand-dressing, on account of the labour and time involved, is only applicable on farms where a small number of pigs are kept, and even then it must be very thoroughly carried out if good results are to follow. The following materials are used for this method: (1) Crude petroleum (fuel oil); (2) sulphur and oil (1 part flowers of sulphur to 4 parts raw linseed oil); (3) kerosene and lard (mixed in proportion of ½ pint kerosene to 1 lb. lard). These remedies can be applied with a brush, distributed in a thin coating over the entire surface of the head and body, including the inner surfaces of the ears and between the thighs. As before mentioned, the dressing must be repeated after an interval of about a week.

Dipping.

Dipping is by far the most effective and economical method of treatment. Where a number of pigs are kept a dip becomes a necessity. Where a small sheep-dip is available this answers the purpose, but the erection of a small concrete dip suitable for dipping pigs is not very expensive, and will quickly defray its cost in labour-saving and from the results obtained in getting rid of the disease. Where a dip is available, pigs can readily be cleaned of lice by putting them through; this in itself can be recommended as having a marked influence on the condition of the animals, apart altogether from the treatment of mange.

The most effective materials used for dipping pigs for mange are: (1) Crude petroleum (fuel oil), (2) lime and sulphur.

Petroleum is recommended as the most effective and most convenient dip. Two dippings at most are sufficient for curing the disease, whereas with the lime and sulphur dip four dippings at intervals of a week are necessary to effect a cure. Fuel oil is obtainable at a low cost in most towns. The oil is poured on top of water in the dip to a depth of 6 in. or 8 in., floating on the water. In going through the dip every part of the pig's body gets a coating of the oil.

The lime and sulphur dip is prepared as follows: Mix 25 lb. of flowers of sulphur with 12½ lb. of good quicklime. Grind the mixture with water until a smooth cream without lumps is obtained. Transfer this to a boiler capable of boiling 20 gallons; bring the volume of the

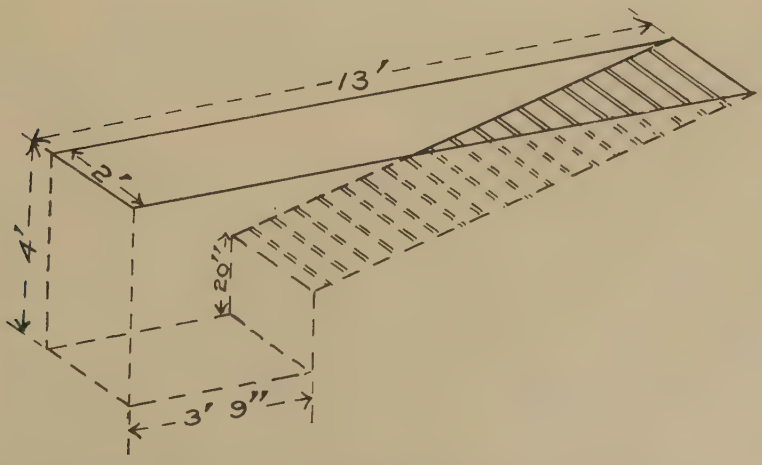
cream to 20 gallons by the addition of water; boil and stir during half an hour. The liquid should then be of dark-red colour: if yellowish, continue the boiling until the dark-red colour is obtained, keeping the volume at 20 gallons. After the liquid has cooled, decant it from any small quantity of insoluble residue, and make up the volume to 100 gallons with water.

Full particulars of dips and dipping-fluids to use are furnished by Live-stock Division officers to pig-breeders having the disease among their pigs. It is essential that all pigs on the farm should be dipped in order to effect complete eradication of the trouble.

Dirty condition of the pigs' skin, as, for instance, the presence of much mud, will naturally retard the action of the dipping-material, and in such cases cleansing of the skin with brush, soap, and water previous to dipping is recommended. If washing is necessary, the pigs must be dry before the application of oil.

A good Type of Dip.

Description of a concrete dip constructed by a Manawatu farmer for treating pigs, and which is proving very successful, may be of value. This dip is 13 ft. long, 4 ft. deep, and 2 ft. wide. The bottom of the well is 3 ft. 9 in. long, and is terminated by a concrete ledge 20 in. high from which the walk-out slope leads to the draining-pen (see diagram). From the ground-level the concrete wall on either side of the dip is raised to about 1 ft., and on top of this a wall of iron 4 ft. high extends to the roof. This side protection is necessary to ensure return of the oil to the dip, as when a pig goes through considerable splashing of oil occurs. A short race leads into the dip, and the concrete floor at the entrance is hollowed or "dished," so that the pig slides in easily. A small draining-pen is also provided to ensure return of the oil draining off the pigs. The dip is filled



(The upper structure of the dip, described in text, is not shown in diagram.)

with water to a depth of about 2½ ft. The oil is poured on top of this to a depth of 6 in. to 8 in. requiring about 70 gallons of oil. The material for this dip cost £15, and the owner states he can dip pigs at the rate of one hundred per hour. Smaller modifications can no doubt be used. For dipping small pigs an old oil-drum can be conveniently adapted.

Disinfection.

Along with direct treatment of pigs, very thorough measures of disinfection are necessary in order to remove the infection of mange on a farm. All litter must be removed and either burned or buried. Pens should be thoroughly sprayed and floors washed with strong disinfectant. All woodwork should be either tarred or limewashed; this also applies to all rubbing places, such as gates, posts, &c.

It is advisable to shift pigs after dipping to a fresh site on the farm, otherwise reinfection will occur from infected places. Pig-pens occupied by diseased pigs can be left unoccupied, after thorough disinfection, for six weeks, when it is considered the infection will have died out; provided the disinfection has been thoroughly done.

WHEAT VARIETY TRIALS IN THE SOUTH ISLAND, SEASONS 1928–29 TO 1930–31.

Fields Division, Department of Agriculture.

Prior to the season 1928–29 wheat-variety trial work of the Department of Agriculture carried out in recent years was confined to the Ashburton Experimental Farm and a trial in co-operation with Canterbury Agricultural College, Lincoln.* The differential effect of soil-type on the yields of varieties rendered it desirable to test the main varieties at different places, and a start was made on this scheme in 1928–29. In 1929–30 the Department commenced active co-operation with the then newly established Wheat Research Institute in the matter of variety trials, and the work at the present time is done very largely on behalf of the Institute.

For purposes of this report the trials here described are divided into two classes—namely, "Yield" trials and "Quality" trials.

"Yield" Trials.

The main object of these tests was to determine the best yielding varieties for different districts. Solid-straw Tuscan was used as the standard variety with which all other varieties were compared. Experiments were arranged so that there would be ten replicated plots of each variety other than Solid-straw Tuscan. The Tuscan occupied every third plot throughout each experiment, so that every varietal plot fell immediately alongside a plot of the standard variety. [illegible] indicating

* For previous reports see this *Journal* for September, 1925, p. 152; November, 1926, p. 317; November, 1927, p. 314; June, 1928, p. 378.

varieties by numbers 1 to 5 and Solid-straw Tuscan by "S," the arrangement of plots was as follows: 1, S, 2, 3, S, 4, 5, S, 1, 2, S, &c. Using an odd number of varieties other than the standard enabled the plots of any particular variety to fall to the right and left of the standard alternately. Each plot was 2 chains long and seven coulter rows wide, with 14 in. between plots.

Rate of seeding: In 1930–31 a flat rate of seeding of 2 bushels per acre was adopted for each variety. It was expected that this amount of seed would be slightly in excess of the optimum rate in most cases, and that the use of a little more seed than the optimum would not have any adverse effect on yield. Further, the possibility of any particular variety being penalized by too light a seeding would be obviated. There is good experimental evidence to indicate that sowing a little more seed than is required to produce maximum yield for any particular conditions does not have an adverse effect on yield, and this evidence, confirmation of which is being sought in trials this year, determined the seeding practice adopted.

Manuring: In nearly all cases 1 cwt. of superphosphate per acre was sown with all varieties.

"Student's" method was used in computing the statistical significance of yield data, each variety being compared directly with Solid-straw Tuscan.

"Quality" Trials.

The chief object of these trials was to provide seed for the Wheat Research Institute of the high-baking-quality wheats of the Marquis type, from different districts, for the purpose of comparing their milling and baking qualities with those of Solid-straw Tuscan grown under the same conditions. At the same time yield determinations have been made; but, as plots have been sown in duplicate only, the results cannot be viewed as being highly reliable.

Season 1928–29.

Three yield trials were laid down in 1928, but only two of these were harvested, the third being badly infested with weeds. Details of the trials carried to completion follow, and the yields are shown in Table 1.

(1) Trial No. 16/3/7: F. J. Horrell, Horrelville, Canterbury.

Date sown, 22/5/28. Varieties and dates of harvesting: Major cut 26/1/29; Solid-straw Tuscan, Solid-straw Velvet, Marquis, and Variety 11/52/10 cut 28/1/29. When inspected on 28/11/28 all varieties were looking well, especially Variety 11/52/10. Major was affected with loose smut. On 26/1/29 Major was dead ripe. Variety 11/52/10 showed the least tendency to lodge.

(2) Trial No. 16/3/159: W. J. Crozier, Mitcham, Canterbury.

Date sown, 5/7/28. Major cut 31/1/29; Marquis cut 1/2/29; Tuscan and Variety 11/52/10 cut 5/2/29.

NOTE.—Variety 11/52/10 was a crossbred which did not prove sufficiently satisfactory to be worth keeping.

Table 1.—Summary of Yields, Season 1928–29.

Variety.	(1) F. J. Horrell.		(2) W. J. Crozier.	
	Yields in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yields in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan ..	47·5	..	60·5	..
Major	49·7	+2·2	55·0	−5·5
Variety 11/52/10 ..	38·9	**−8·6**	55·0	−5·5
Marquis	..	..	52·9	−7·6
Solid-straw Velvet ..	49·7	+2·2	..	..

NOTES.—Differences printed in heavy type are statistically significant. A plus sign preceding a figure indicates an increase, and a minus sign a decrease; this applies to all tables. Experiments are numbered as in the text.

In experiment (2) the figures were not examined statistically, but it is practically certain that differences of varieties from Solid-straw Tuscan are significant.

Season 1929–30.

Three yield trials and three quality trials were laid down in 1929. Details follow, and the yields under the two classes are given in Tables 2 and 3 respectively.

YIELD TRIALS.

(3) Trial No. 16/3/7: F. J. Horrell, Horrelville, Canterbury.

Date sown, 29/5/29. Major and Marquis cut 31/1/30; Solid-straw Tuscan, Solid-straw Velvet, and Variety 1/79/13 cut 5/2/30. When inspected on 6/12/29 Major and Marquis were much ahead of the other varieties, and Variety 1/79/13 was backward. On 31/1/30 Major and Marquis were quite ripe; all the other varieties much behind. The latter were cut on 5/2/30, when Solid-straw Velvet and Variety 1/79/13 were the ripest, whereas Solid-straw Tuscan could have stood another day or so.

(4) Trial No. 16/3/256: R. Campbell, Dromore, Canterbury.

Date sown, 31/5/29. Major and Marquis cut 31/1/30; Solid-straw Tuscan, Solid-straw Velvet, and Variety 1/79/13 cut 5/2/30. When cut on 31/1/30 both Major and Marquis had been shaken slightly by strong north-westerly winds. On 5/2/30 the Variety 1/79/13 was slightly on the green side; the remaining varieties were ripe.

Table 2.—Yields of Varieties in "Yield" Class Trials, Season 1929–30.

Variety.	(3) F. J. Horrell.		(4) R. Campbell.		(5) W. Kelland.	
	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan	42·2	..	21·4	..	52·6	..
Solid-straw Velvet	50·0	**+7·8**	..	..	..	..
Major	48·2	**+6·0**	20·2	**−1·2**	44·6	**−8·0**
Marquis ..	42·8	+0·6	16·0	**−5·4**	40·3	**−12·3**
Variety 1/79/13..	38·2	**−4·0**	17·4	**−4·0**	49·5	**−3·1**

(5) Trial No. 16/3/109: W. Kelland, Northdown, Canterbury.

Date sown, 28/5/29. Solid-straw Tuscan, Major, Marquis, and Variety 1/79/13 all cut 6/2/30. Major and Marquis ripened some time before Solid-straw Tuscan and Variety 1/79/13. All were cut at the same time and were fit, Major and Marquis being dead ripe, but there was no loss as a result of allowing them to stand.

NOTE.—Variety 1/79/13 is a crossbred which was put under further trial in 1930–31.

QUALITY TRIALS.

(6) Trial No. 16/3/340: H. D. Burt, Hawarden, North Canterbury.

Date sown, 18/6/29. Solid-straw Tuscan, Marquis, Garnet, Red Fife, White Fife, and Yeoman II were all cut on 22/2/30. Garnet was badly shaken, and along with Marquis and Solid-straw Tuscan was badly lodged at harvest-time. Red Fife was slightly lodged, and White Fife and Yeoman II were standing well.

Very unusual circumstances attended this trial. Mr. Burt reported that a heavy frost in late October damaged the Solid-straw Tuscan very badly, but did not affect the other varieties. It is very unusual for wheat to be badly damaged by frost before coming into ear. The effect of the frost is reflected in the yield (see Table 3).

(7) Trial No. 16/3/375: A. G. Edgar, Rangitata, South Canterbury.

Date sown, 6/8/29. Solid-straw Tuscan, Marquis, Garnet, Red Fife, and Yeoman II were all cut on 13/2/30. At time of harvesting Garnet was overripe, and nearly all of the grain was taken by birds; Red Fife and Marquis were dead ripe; Solid-straw Tuscan was ripe, and White Fife was fit to cut, although grain was soft.

(8) Trial No. 16/4/158: E. Haugh, Duntroon, North Otago.

Date sown, 29/8/29. Solid-straw Tuscan, Marquis, Garnet, and Red Fife were all harvested on 21/2/30. An attack of Hessian fly reduced the yields somewhat.

Table 3.—Yields of Varieties in "Quality" Class Trials, Season 1929–30.

Variety.	(6) H. D. Burt.		(7) A. G. Edgar.		(8) E. Haugh.	
	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan	16·5	..	60·7	..	27·7	..
Marquis ..	33·3	+16·8	47·8	−12·9	26·0	−1·7
Red Fife ..	47·4	+30·9	53·5	−7·2	20·1	−7·6
Garnet ..	30·9	+14·4	*	*	25·5	−2·2
White Fife ..	41·0	+24·5	..	..	..	..
Yeoman II ..	39·0	+22·5	51·7	−9·0	..	..

* Taken by birds.

Season 1930–31.

Nine yield trials and three quality trials were sown in 1930. Eight of the former and two of the latter were carried to completion. Details follow, and the yields are summarized in Tables 4 and 5.

Yield Trials.

(9) Trial No. 16/3/427: W. H. Savage, Waiau, North Canterbury.

Date sown, 21/5/30. All varieties (Solid-straw Tuscan, Major, Marquis, Variety 1/79/13, and Dreadnought) cut 26/1/31. On 17/11/30 the Marquis, Dreadnought, and Major plots appeared much thinner than the others. Apparently they had not germinated as well as the other plots, or else the harrowing had a more severe effect on these plots (the crop was harrowed three times). When cut on 26/1/31 all plots were ripe, and Variety 1/79/13 had shaken slightly.

(10) Trial No. 16/3/7: F. G. Horrell, Horrelville, Canterbury.

Date sown, 30/5/30. Major and Marquis cut 31/1/31; Victor cut 8/2/31; Solid-straw Tuscan, Dreadnought, Solid-straw Velvet, Variety 1/79/13, and Yeoman cut 5/2/31. On 5/2/31 Dreadnought was dead ripe; Yeoman was green in the stem, but, as the grain was shaking, it was cut; the remaining varieties were in good condition for cutting. At threshing, Dreadnought shook badly despite careful handling, and a great deal of grain was lost. Victor and Yeoman were also difficult to handle to prevent loss.

(11) Trial No. 16/3/429: Rangiora High School, North Canterbury.

Date sown, 21/6/30. Major cut 22/1/31; Solid-straw Tuscan, Victor, Yeoman, Solid-straw Velvet, and Hunter's cut 6/2/31. On 22/1/31 Major was ripe; the remainder appeared to be ripening evenly. On 6/2/31 Victor and Yeoman were still green in the stem, but as they had commenced to shake they were cut with the other varieties. Hunter's should have been cut the previous day and had shaken slightly.

(12) Trial No. 16/3/426: J. Ruddenklau, Methven, Canterbury.

Date sown, 6/6/30. All varieties (Solid-straw Tuscan, Major, Marquis, Solid-straw Velvet, Dreadnought, and Variety 1/79/13) cut 11/2/31. On 12/1/31 the crop had not done well; the growth was short and heads were not well filled. Variety 1/79/13 was easily the poorest, and was very disappointing. Dreadnought compared favourably with Solid-straw Tuscan. On 11/2/31 Solid-straw Velvet and Solid-straw Tuscan appeared fairly bad with stem-rust; Marquis was the most immune. Major and Marquis might have been cut a day or two sooner with advantage, but no grain was shaken. All other varieties were just right for cutting.

(13) Trial No. 16/3/428: A. Amos, Wakanui, Canterbury.

Date sown, 27/5/30. Marquis cut 3/2/31; Major cut 4/2/31; Dreadnought cut 5/2/31; Solid-straw Tuscan, Velvet, Victor, Yeoman, and Solid-straw Velvet cut 9/2/31. When cut Yeoman and Victor were rather on the green side; the remainder were ripe. All varieties had suffered to some extent from birds; and there had been a certain amount of shaking, Dreadnought being the worst in this respect. There was a considerable amount of stem-rust on the Velvets, Solid-straw Tuscan, Victor, Dreadnought, and Yeoman. Major had slightly less and Marquis very little rust. On 7/2/31 a large mob of sheep broke into the paddock and did considerable damage to the stooks. Consequently the comparative yields are of little value and are not shown in the table of yields.

Table 4.—Yields of Varieties in "Yield" Class Trials, Season 1930–31.

Variety.	(9) W. H. Savage, Waiau.		(10) F. G. Horrell, Horrelville.		(11) High School, Rangiora.		(12) J. Rudden-klau, Methven.		(14) T. H. Ivey, Saltwater Creek.		(15) W. Kelland, Tycho.		(16) J. Newlands, Ngapara.		(17) C. R. Sheat, Moneymore.	
	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan ..	31·0	..	69·5	..	50·8	..	31·5	..	44·2	..	63·1	..	46·3	..	51·7	..
Major	25·7	**−5·3**	77·5	**+8·0**	49·9	−0·9	32·9	**+1·4**	38·8	**−5·4**	56·6	**−6·5**	45·8	−0·5	59·1	**+7·4**
Marquis 10B ..	13·0	**−18·0**	55·1	**−14·4**	..	..	28·6	**−2·9**	..	..	38·7	**−24·4**	..	..	54·4	**+2·7**
Solid-straw Velvet ..	32·5	**+1·5**	73·0	**+3·5**	52·2	**+1·4**	32·4	+0·9	..	..	61·2	**−1·9**	50·7	**+4·4**	59·2	**+7·5**
Velvet	..	..	..	..	..	..	..	..	..	..	..	..	42·4	**−3·9**	..	..
Dreadnought ..	28·5	**−2·5**	63·5	**−6·0**	..	..	29·7	**−1·8**	36·2	**−8·0**	43·8	**−19·3**	42·2	**−4·1**	..	..
Dreadnought 5/27 ..	..	..	..	..	..	..	..	..	34·8	**−9·4**	..	..	42·2	**−4·1**	..	..
1/79/13	26·7	**−4·3**	59·4	**−10·1**	..	..	25·5	**−6·0**	..	..	..	..	43·0	**−3·3**	45·2	−6·5
Victor	..	..	70·8	**+1·3**	50·4	−0·4	..	..	..	..	..	..	..	..	..	..
Yeoman II ..	..	..	65·0	**−4·5**	49·0	**−1·8**	..	..	38·0	**−6·2**	56·9	**−6·2**	..	..	..	..
Hunter's	..	..	..	..	36·7	**−14·1**	..	..	37·6	**−6·6**	..	..	49·2	**+2·9**	..	..
Garnet	..	..	..	..	..	..	..	..	..	..	..	..	..	..	54·1	**+2·4**

NOTES.—Differences which are printed in heavy type are statistically significant. Results of Trial No. 17 were not examined statistically. Variety 1/79/13 is a crossbred which is not being retained. Dreadnought 5/27 is a selection from Commercial Dreadnought made by Mr. J. W. Hadfield, Agronomist, Department of Agriculture; the selection yielded much better than Commercial Dreadnought in preliminary trials.

(14) Trial No. 16/3/415: T. H. Ivey, Saltwater Creek, South Canterbury.

Date sown, 27/5/30. All varieties cut 21/2/31 (Solid-straw Tuscan, Major, Hunter's, Yeoman, Dreadnought, and Dreadnought 5/27). On 4/2/31 Yeoman was a little on the green side in one or two plots; Hunter's was also a little green, but all the other varieties were ripe, especially Major. Dreadnought 5/27 appeared to have the largest heads and grain, but Dreadnought was riper and had a smaller grain. On threshing, the two Dreadnought varieties were shaking freely and Hunter's was shaking slightly.

(15) Trial No. 16/3/109: W. Kelland, Tycho, South Canterbury.

Date sown, 21/5/30. All varieties cut 3/2/31 (Major, Solid-straw Tuscan, Yeoman, Solid-straw Velvet, Dreadnought, and Marquis 10B). On 19/1/31 the crop was ripening fast, due to continued dry north-westerly weather. Major was nearly fit to cut; the grain was fairly hard but a little pinched. The grain was still milky in the case of Solid-straw Tuscan, Solid-straw Velvet, Dreadnought, and Yeoman. The heads of the latter had a green tinge. Marquis was still milky, but further advanced than the four varieties previously mentioned. Dreadnought and Marquis were inclined to shake at threshing.

(16) Trial No. 16/4/222: J. Newlands, Ngapara, North Otago.

Date sown, 4/6/30. Major cut 10/2/31; Solid-straw Tuscan, Hunter's, Solid-straw Velvet, Dreadnought, Dreadnought 5/27, and Variety 1/79/13 all cut 20/2/31. On 13/1/31 Solid-straw Tuscan appeared to be the best variety, showing a nice length of straw with a large and well-filled ear. On 10/2/31 the Major plots were very much further advanced in the ripening stage than was the case with the remainder.

(17) Trial No. 16/4/254: C. R. Sheat, Moneymore, South Otago.

Date sown, 27/9/30. Marquis and Garnet cut 16/3/31; Major cut 27/3/31; Solid-straw Velvet and Variety 1/79/13 cut 8/4/31; Solid-straw Tuscan cut 29/4/31. On 16/3/31 Variety 1/79/13 was still in the green stage, and appeared to be prone to attack of leaf and stem rust; Solid-straw Tuscan was very green; and Major and Solid-straw Velvet were still slightly on the green side and not ready for cutting.

NOTE.—It was not convenient in this experiment to weigh individual plots; all plots of each variety were bulked and threshed together. Statistical examination of results was not possible.

QUALITY TRIALS.

(18) Trial No. 16/3/432: H. D. Burt, Harwarden, North Canterbury.

Date sown, 5/6/30. Marquis O, Marquis 10B, Reward, and Garnet cut 16/1/31; Solid-straw Tuscan and White Fife cut 26/1/31. On 17/11/30 Garnet appeared to be the best, being of a good colour and furthest advanced; White Fife did not show as much growth as the other varieties. On 16/1/31 Reward and Garnet were dead ripe and had shaken slightly, more especially on the outside rows, where the wind had threshed the heads against the unripe Tuscan plots.

(19) Trial No. 16/3/457: Canterbury Seed Co., Leeston, Canterbury.

Date sown, 29/8/30. Garnet cut 23/1/31; Solid-straw Tuscan, Garnet, Reward, and Marquis O cut 4/2/31. The seed of all varieties had been hot-water treated, and Marquis O and Reward had suffered considerably from germination injury. The lowered germination and consequently thinner crop of the Reward and Marquis O delayed ripening to such an extent that these plots ripened at the same time as the Tuscan plots.

(20) Trial No. 16/3/433: Jamieson Bros., Dromore, Canterbury.

Date sown, 7/7/30. Reward and Garnet cut 14/1/31; Marquis O and Marquis 10B cut 23/1/31; Solid-straw Tuscan and White Fife cut during February. On 14/1/31 the plots had been dried out badly by the north-westers prevailing. All varieties had been badly attacked by birds, which appeared to have taken 75 per cent. of the grain. White Fife had the tallest growth and, together with Tuscan, was late in maturing. Owing to the severe bird-attack yields of the varieties in this trial were not taken.

Table 5.—Yields in "Quality" Class Trials, Season 1930–31.

Variety.	(18) H. D. Burt.		(19) Canterbury Seed Co.	
	Yields in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan..	27·8	..	43·0	..
Garnet	21·9	−5·9	27·0	−16·0
Reward	21·0	−6·8	16·7	−26·3
White Fife ..	18·3	−9·5	..	..
Marquis O ..	18·0	−9·8	24·9	−18·1
Marquis 10B ..	19·5	−8·3	..	..

General.

Trial of most of the varieties reported on in this article is being continued in the present season (1931–32), after which some fairly definite conclusions should be arrived at. The close association with the Wheat Research Institute will add considerably to the value of future work.

The co-operation of those farmers who assisted in the trials here recorded is gratefully acknowledged. The field work in Canterbury has been carried out, under the supervision of Mr. R. McGillivray, Fields Superintendent, Christchurch, by the following officers: A. Y. Montgomery, late Assistant Crop Experimentalist; E. M. Bates, Instructor in Agriculture, Ashburton; W. Stafford, Instructor in Agriculture, Christchurch; R. A. Calder, Instructor in Agriculture, Timaru; K. M. Montgomery, Fields Instructor, Timaru. In Otago the work has been carried out, under the supervision of Mr. R. B. Tennent, Fields Superintendent, Dunedin, by T. Sellwood, Instructor in Agriculture, Oamaru, and A. Hume, Instructor in Agriculture, Dunedin.

—A. W. Hudson, Crop Experimentalist, Plant Research Station, Palmerston North.

WEEDS IN LAWNS AND GREENS.

COMPETITION EFFECTS AND CONTROL BY TREATMENT WITH CHEMICAL SPRAYS.

E. BRUCE LEVY, Agrostologist, and E. A. MADDEN, Assistant in Agrostology, Plant Research Station, Palmerston North.

ECOLOGICAL CONSIDERATIONS.

PERHAPS no grassland subject is of more popular interest than that concerned with the formation and upkeep of lawns, whether the lawn be about the home and buildings or in the field of sport. The weed-control of these lawns is a matter of prime concern, whether from an æsthetic aspect purely or from the pique and chagrin of a well-directed ball gone astray.

The presence of weeds in a lawn is essentially the outcome of the environment set up, and weed-control lies in accurately gauging the major factors and the interrelation of these that constitute the make-up of the total environment—the factors of soil fertility, soil moisture, soil acidity or alkalinity, soil compaction, soil aeration, soil flora and fauna, sward defoliation, the growth-form of the species of the sward and the various strains of those species, together with that intricate competition-complex among the sward components themselves—grasses, clovers, and weeds.

In all lawns we are dealing essentially with two growth-forms—(1) the stiffly erect, needle-leaved, and (2) the low, prostrate or semi-prostrate broad-leaved plants. Lawn-grasses, for the most part, belong to the first group; clovers and weeds of lawns belong to the latter. In lawn-management the environment set up by close and continuous mowing favours essentially the low and prostrate-leaved plants, and unduly prejudices the growth of the tall erect-leaved growers. In other words, the grasses of the green are overpruned, and their low cutting creates essentially the right condition for low-growing mat weeds such as pearlwort and moss, and for those broad-leaved plants such as field-daisy, catsear, dandelion, rib-grass, selfheal, white clover, &c. These escape overpruning by their leaves being short or closely appressed to the ground. Thus is established on the ground floor of the sward a dense mat of foliage that precludes the possibility of any grass-leaves lying flat and closely appressed to the ground to escape defoliation. This intense ground-floor competition of weeds, plus the overpruning of the grass-leaves through being forced up erect by the ground-floor competition, are the two major factors that throw the lawn environment in favour of clover and weeds rather than grass. (Figs. 1–4.)

If we can destroy this ground-floor competition of clover and weeds we shall get rid of one essential factor that leads to the elimination of the grass from the sward (Figs. 6–8); and if along with this goes hand-in-hand the provision of nutrients for grass, water, cultural aids, and the control of soil fungi and insects, we shall get a long way further to the perfection of our playing swards. In the lawns about the gardens and buildings we can help greatly by keeping the mower higher, thus pruning the grass less severely and allowing this to form a higher-story shade,

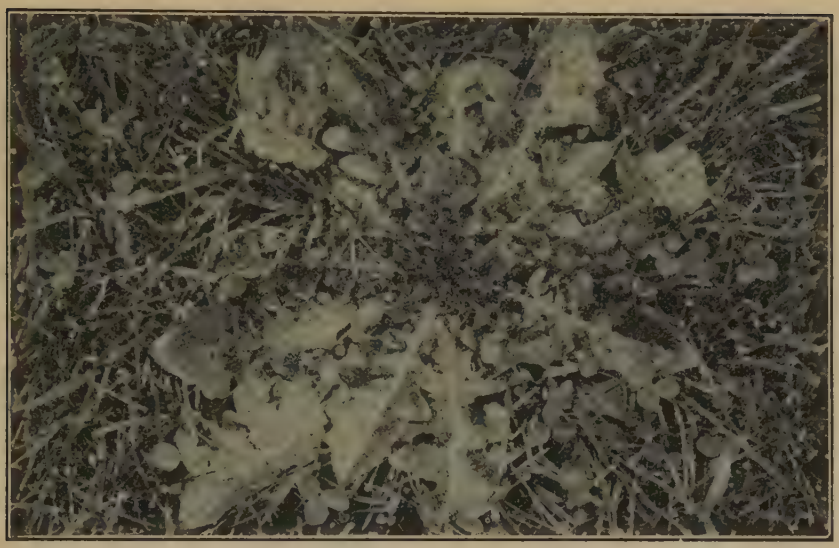


FIG. 1. YOUNG PLANT OF CATSEAR SHOWING BROAD-LEAVED ROSETTE IN LAWN.

The finer grasses of the lawn are quite unable to compete with a growth form of this nature. The more closely the lawn is cut the more closely to the ground are these broad leaves appressed. Total elimination of the grass eventually results from the shade of these leaves.

FIG. 2. FIELD-DAISY SHOWING CLOSELY PACKED CROWNS FORMING A DENSE ROSETTE WHICH OFFERS COMPETITION SIMILAR TO THAT OF CATSEAR.

Here, again, under close cutting these flat leaves become closely appressed to the ground, resulting in total elimination of the fine-leaved grasses within the zone of the field-daisy plant.

[Photos by E. Bruce Levy.

FIG. 3. SLENDER CHICKWEED ELIMINATING GRASS IN THE LAWN (BROWN-TOP).

The weed does this by forming under continuous mowing a ground-floor mat so dense that tillering of the grass is inhibited, and what leaves manage to get through are so overpruned by the mower as to result later in death of the grass. This plant of chickweed is spreading to the left.

FIG. 4. WHITE CLOVER IN THE LAWN FORMING SO DENSE A GROUND-FLOOR COMPETITION AS TO ELIMINATE THE GRASS.

Under such conditions tillering of the grass is inhibited and what leaves get through are forced erect and are overpruned. The disposition of the white-clover leaves is such as to escape the knife of the mower, and the removal of the grass-leaves enables full sunlight to play on the broadly expanded leaves, giving perfect conditions for assimilation of the essential materials for plant-growth.

[*Photos by E. Bruce Levy.*

as it were, that is harmful to the ground-floor mat weeds. The major problems, then, in lawn-making are, firstly, to destroy this ground-floor competition; then to top-dress the lawn with a complete grass-promoting manure; to water to the requirements of the grass species present; and to give cultural aids such as scarifying or top-dressing with soil that has been sterilized to destroy weed seeds.

Brown-top and Chewings fescue are the best grasses for lawns generally, and we should aim to create and maintain a condition essentially favourable to their growth, and at every available opportunity give the weeds and clovers a set-back, either by allowing the lawn to get away fairly long during periods of off-play, or by actual removal of the weeds by spudding or killing *in situ* by chemical means. The purpose of this article is to offer some explanation of cause and effect of weeds in lawns, and to put forward a method of weed-control in lawns by spraying with chemical sprays, giving some experience in the use of arsenic pentoxide (AS_2O_5).

Elimination of Weeds by Chemical Means.

Elimination of weeds by chemical means may be secured in two ways: (1) By caustic and poisonous action on the tissues of the plant, killing by direct contact, and (2) by so altering the chemical nature of the soil by repeated doses of any one material as to make the habitat untenable by weed growths. Of these two methods, the former—killing by contact—appeals to the writers as being the better, for when destruction of the weed has taken place the growing-conditions as far as the soil is concerned are unaltered and still favourable for the surviving grass.

Fortunately, there seems a sufficiently wide susceptibility range between the underground-tillered, fine-foliaged, hard-leaved grasses and surface-crowned, broad- and soft-leaved weeds to apply a contact-kill spray sufficiently concentrated to kill the weeds and yet not unduly injure the grass. Under this method the soil conditions remain essentially the same, and once the grass recovers from the browning-off as a result of the treatment good uniform growth is possible, whereas by creating an unduly acid and poor mechanical condition in the soil the growth of grass is considerably impaired, particularly in the case of Chewings fescue. Brown-top certainly can stand fairly acid conditions, but it grows more vigorously, tillers better, and forms a denser turf on well-conditioned soils. The writers hold that it is better as a general principle to strike ideal growing-conditions as far as the soil itself is concerned, and destroy weeds and clovers by contact poisonous sprays rather than modify soil conditions to an unfavourable state for plant-growth beyond the tolerance point of weeds and clovers. It is hard to imagine this carried to such a point that weeds such as penny-wort, waxweed, Westport weed, pearlwort, catsear, plantain, pennyroyal, &c., could be eliminated without also eliminating the grass. We have in New Zealand certain soils so unfavourable to grass that only certain of these weeds will thrive there.

At the present time the most general chemical treatment to effect a setback or directly kill weeds and clover in lawns consists of the use of sulphate of ammonia, sulphate of iron, ferrous ammonium sulphate, sulphate of copper, or calcium cyanamide. All these have

FIG. 5. SINGLE PLANT OF SUCKLING CLOVER COMMENCING TO FORM A DENSE GROUND-FLOOR COMPETITION.

During the growth of this annual the grass of the lawn is smothered, and when death of the annual normally results in summer open spaces are left in the lawn, which offer favourable condition for re-establishment of annuals in the autumn.

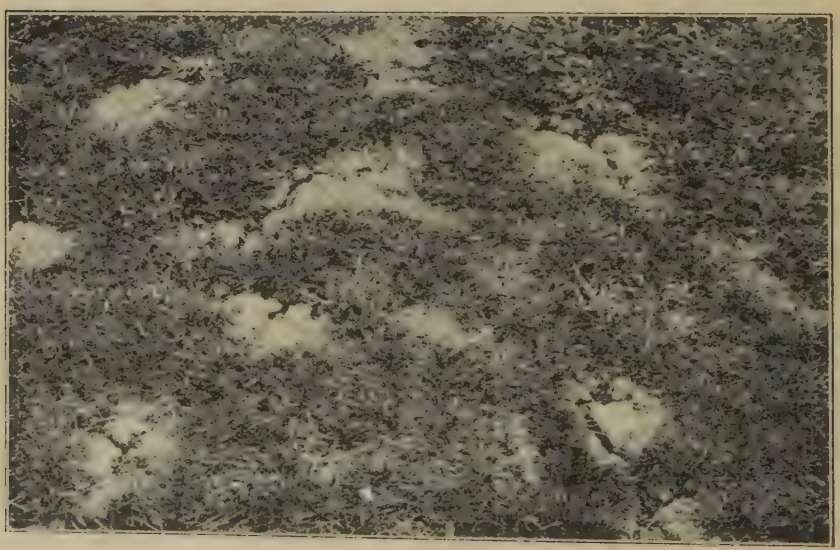


FIG. 6. DESTRUCTION OF GROUND-FLOOR COMPETITION BY SPRAYING WITH ARSENIC PENTOXIDE.

This photo shows total clearance of weeds from a badly infested lawn. Chewings fescue is here seen spreading back over the bared patches. By destroying weeds and removing this competition an excellent opportunity to introduce more grass is afforded. Seeding may be done three weeks after spraying, the area being well scarified prior to sowing of seed.

[*Photos by E. Bruce Levy.*

a caustic and contact-kill effect when applied at the rate of about 6 cwt. per acre of green, and they burn badly at a much less rate per acre than this, but most of them also have a decidedly harmful influence on the soil of greens when persistently applied for this purpose. As part of the plant-food requirements of greens all, except sulphate of copper, are excellent manures, but when applied to the point of altering soil conditions so as to become unfavourable to plant-growth it is time to make a halt in their application.

Among some green-keepers and lawn-makers certain weeds are held quite desirable in a green—for example, pennywort, waxweed, yarrow, and certain species of Cotula, such as Westport weed ; and if one is unfortunate enough to possess a green where it is absolutely impossible to create and maintain a grass condition in the soil, then certain weeds do make a playable green, but the writers' contention is that one cannot attain to perfection in a fine grass green and at the same time have the competition of any ground-floor weeds or clovers. They must be destroyed before a hundred-per-cent. perfect fine-leaved grass green can be attained. The pennywort, waxweed, and Westport-weed greens are best attained by generally ignoring the accepted practices of good green-keeping. Continuous close cutting, low fertility, moisture-laden stagnant conditions favour these ground-floor weeds and eliminate the grass.

Then there are those greens where annual weeds predominate and are troublesome, to say the least—Poa annua, suckling clover, clustered clover, Onehunga weed, parsley piert, toad-rush, and the like. For annuals to perpetuate themselves in any sward, that sward must be open. There is infinitely less chance of the annual re-establishing itself in a dense turf as compared with the open turf, and the more compact we can keep the turf of perennial fine grasses the fewer annuals will there be in the lawn.

Certain annual weeds are capable of prostrating themselves and surviving the cut of the mower however low the knife is set. These form during the growing-period a compact ground-floor cover, and offer competition similar to that of the ground-floor perennial weeds (Fig. 5). Furthermore, they can flower and set seed even though mown to the ground. In the autumn, particularly on unwatered greens, the annuals die and the turf opens up, and it is this opening-up that affords easy re-establishment from the shed seed during the autumn. The wear-and-tear on greens through play also makes easy the entrance of annuals on greens.

This annual population can be very largely destroyed by spraying with arsenic pentoxide, but more trouble is experienced owing to the rapidity with which re-establishment from seed is effected in the autumn and spring. Some indication of the enormous crop of seeds of annuals lying dormant in the soil may be gauged from the following experience. A lawn where one of the dominant grasses was Poa annua was sprayed with arsenic pentoxide, and all established plants of this grass were killed. Spraying was done in mid-autumn, and the lawn was raked and reseeded three weeks later, using a seed mixture per acre of 60 lb. brown-top, 60 lb. Chewings fescue, and 30 lb. crested dogstail. Quite a good take of the sown species was secured, but an analysis of the green made two months later showed approximately

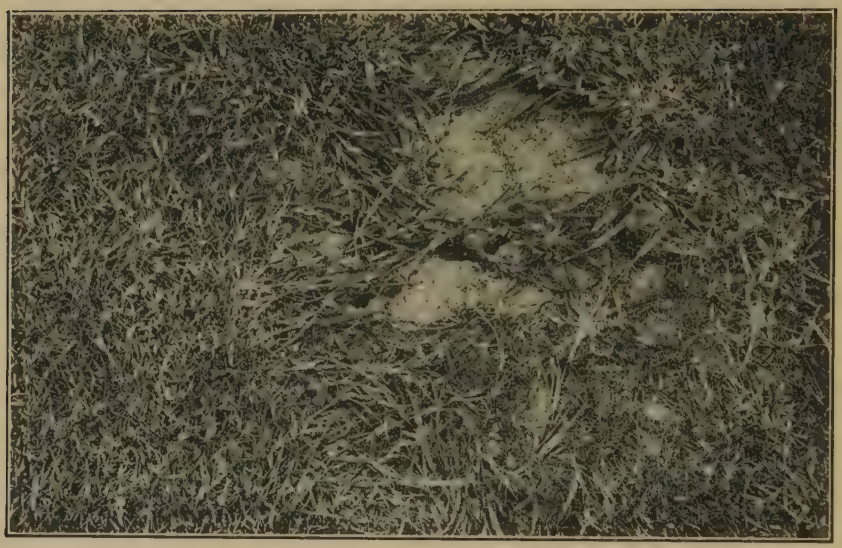


FIG. 7. GROUND-FLOOR COMPETITION OF WEEDS TOTALLY DESTROYED IN LAWN BY SPRAYING WITH ARSENIC PENTOXIDE.

The grass of the lawn here showing is creeping-bent. Note how the shoots and stolons soon invade the area bared of weeds. Raking, top-dressing of soil, and more seed at this stage would rapidly result in a complete grass-sward.

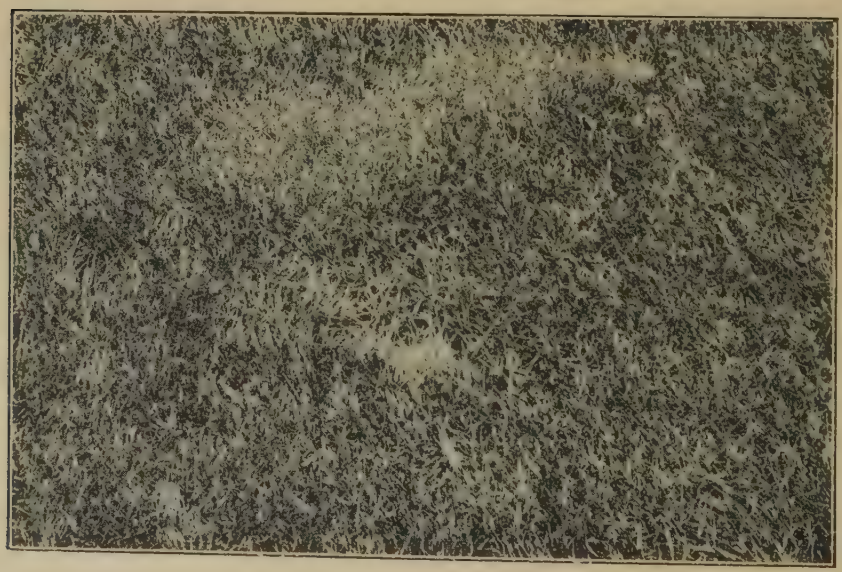


FIG. 8. RECOVERY OF BROWN-TOP AFTER DESTRUCTION OF WEEDS BY SPRAYING WITH ARSENIC PENTOXIDE.

Note in middle of photo how the brown-top has filled in after destruction of weed-growth (catsear). Where a good sward of brown-top is already established and weed-invasion still in an initial stage, spraying with arsenic pentoxide kills the weeds and there should be no need for any reseeding.

[*Photos by E. Bruce Levy.*

ten times as many Poa annua seedlings established as seedlings of the sown species. This but emphasizes the difficulty attendant on the total elimination of Poa annua from greens if reseeding or introduction of additional seed in the top-dressing of soil is permitted. However, the killing of the annual before growth commences in the spring will have two major effects: (1) It eliminates competition during the spring and early summer, and thus allows freer tillering and wider spread of the grasses during this essential growing-period; (2) it affords an opportunity of successfully introducing more seed of the finer perennial grasses.

It must be recognized that reseeding of weed-infested greens will be necessary after spraying with arsenic pentoxide, in order to fill up the spaces bared by the kill of weeds. Arsenic-pentoxide treatment of greens kills weeds, but it does not claim to make grass grow where no grass existed before. It would probably surprise most green-keepers were it possible to remove mechanically from the green everything but the fine-leaved permanent grasses. Before applying the seed the green should be well scarified by raking, and manurial top-dressing should be made as soon as the seed has shown through the soil, or even at time of seeding-down.

The successful introduction of more grass into an existing sward normally is a difficult matter, due largely to the fact that there is no prepared seed-bed and too much competition for the germinating seeds to establish and thrive. One of the commendable points in regard to arsenic pentoxide as a weed-killer on lawns is that it leaves no harmful after-effects on the soil; and, further, it would appear that once the material has reverted to a non-injurious compound a decidedly beneficial manurial effect is imparted to the green. This, of course, may be due to the rotting of vegetation that has been killed by the arsenic pentoxide rather than to any manurial properties of the arsenic pentoxide itself.

The greatest disadvantage of spraying with arsenic pentoxide is that the whole of the green browns off—grasses, clovers, and weeds—and remains brown for about three weeks. This disadvantage is less apparent in the autumn, when greens are normally browned off to some extent by dry weather. Treating greens that are extremely dried out is not recommended, however, as the grass as well as weeds succumbs to the normal treatment.

The green after having been sprayed, and while brown, may still be played on, and it becomes very fast while in this state. For autumn and spring renovation, however, after scarifying and sowing of seed the green should not be played on until the seed is up and the young sward well established. During this establishment period too much growth of the existing grass of the green should not be permitted, else the establishing seedlings may be smothered by the cover.

Where greens are played on until too late for autumn reseeding the spraying is best left until late winter, and the green then prepared for seeding in the early spring. This will also apply to spraying for the control of annuals. Spraying for annuals may be done after autumn re-establishment has been completed, towards the end of May. June and July should be the best months for control of autumn-established annual weeds. Probably in the spring, however, more annuals will germinate and re-establish, and a further spraying will be necessary

before these commence flowering. Spraying with a weaker solution than 1–80 may be quite effective in destroying young seedlings of annuals, and such strengths will have quite a small browning effect on the grasses of the green.

Once a green is freed of weeds and a good uniform sward of grass secured all over, quite local application of arsenic pentoxide may be made by means of a small hand-syringe to control the odd weeds and clover-plants as these gain entry. Again, light spraying of 1–80 or 1–100 solution, once the grass is in good heart, should be quite sufficient to kill weed seedlings during their establishment. For normal weeds of the lawn one application kills almost 100 per cent., but where the weeds are densely tufted at the crown, as is often the case in old, long-established catsear, rib-grass, &c., in the lawn, then two applications at 1–80 will in general be necessary (Fig. 10). Stronger applications (1–40) applied individually to these multicrowned weeds successfully kill in the one application (Fig. 11). This strength solution also keeps gravel paths free of weeds, but for this purpose a 10-per-cent. solution of sodium chlorate would be equally effective and more lasting.

General Procedure for Spraying with Arsenic Pentoxide.

The lawn should be mown prior to treatment, and the foliage should be quite dry. Any wetness on the foliage dilutes the solution, which may become too weak to kill effectively. Similarly, rain falling within twenty-four hours after application will tend to reduce the efficacy of the spray.

The solution used for general purposes should be at the strength 1–80—that is, 1 lb. arsenic pentoxide to 8 gallons of water. For spraying greens which are in a very dry state or for killing seedling weeds a strength of 1–100 (1 lb. to 10 gallons water) is strong enough; and for wet greens where weeds are vigorous a strength of 1–60 (1 lb. in 6 gallons water) gives best results and is quite safe.

The required quantity of arsenic pentoxide for any one of the foregoing strengths should be dissolved in about 1 gallon of cold water and then diluted to the required strength by adding more water. The solution should be applied at the rate of 240 gallons per acre, and this is best done with a knapsack type of spray-pump fitted with a fine jet, double nozzle. So applied, 240 gallons per acre just nicely wets all foliage, and permits of an even distribution of the poison. If more than 240 gallons of the solution is used per acre, as is possible by using a coarse jet, it will be recognized that in any one application strength more poison per acre is applied, and this greater quantity may cause the death of all vegetation. Similarly, any of the solution spilt on the green when filling the spray-pump may kill the whole of the vegetation where that spilling occurred. It is important, then, not only to make up the correct-strength solution, but also to make certain that it is applied at approximately 240 gallons per acre of green.

From the foregoing it will be seen that very little material is required for the average-sized green. Thus for a bowling-green 120 ft. by 120 ft. approximately 10 lb. of arsenic pentoxide and 80 gallons of water are required. For the average putting-green ($\frac{1}{10}$ acre) 3 lb. arsenic pentoxide and 24 gallons of water suffice.

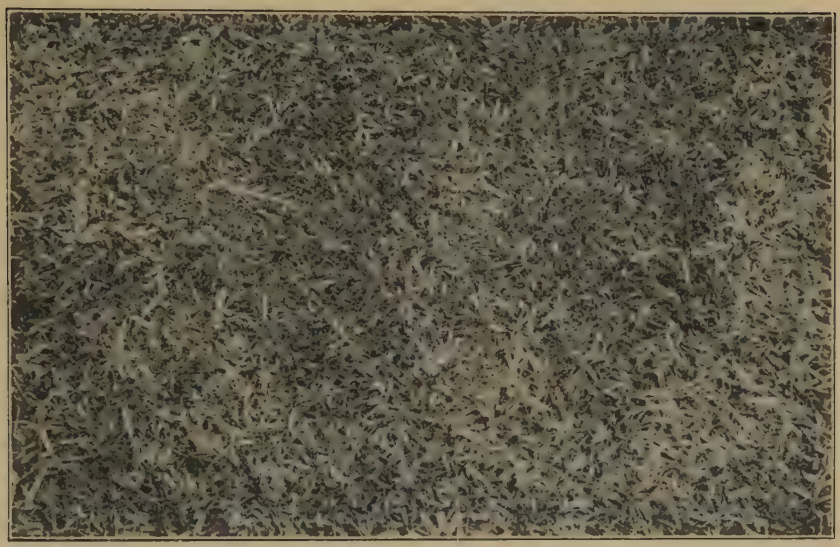


FIG. 9. BROWN-TOP AND CHEWINGS FESCUE LAWN SECURED BY RESEEDING AFTER SPRAYING WITH ARSENIC PENTOXIDE.

Prior to spraying this lawn was all weeds. Three weeks after second spraying the bared surface was well scarified by raking and seed sown. Liberal manurial top-dressing should always accompany surface reseedings made in this way to ensure establishment.

[*Photo by E. A. Madden.*

FIG. 10. OLD MANY-CROWNED PLANT OF CATSEAR IN LAWN.

One application of normal-strength spray seldom effects complete kill, owing to the difficulty of getting spray to the whole of the crown shoots. Two sprayings are successful.

[*Photo by E. Bruce Levy.*

With one pump and water on the spot a bowling-green can be sprayed in about four hours and a half, and the cost of material should not exceed 6s. Sulphate of ammonia or sulphate of iron as weed-killers must be applied at about 6 cwt. or more per acre to be effective. The cost of these materials would be three to four times the cost of arsenic pentoxide.

When spraying, to ensure none of the green being missed, strings should be put down to divide the ground into strips about 4 ft. wide. Binder-twine serves the purpose well. Stock should not have access for about ten days after spraying or until after rain.

Arsenic pentoxide is poisonous, and if the hands are wetted unduly in spraying operations, such as by a leaky pump or by frequently immersing the hands in the liquid, painful burning occurs in the quick of the finger-nails. With reasonable care arsenic pentoxide is safe and agreeable to work with. The pump and tins in which arsenic-pentoxide solution has been mixed should be rinsed with water after use.

Experiences in Use of Arsenic Pentoxide.

On 14th November, 1929, the No. 2 green of the West End Bowling Club, at New Plymouth, was sprayed with arsenic-pentoxide solution at a strength of 1–80 applied at the rate of 176 gallons per acre. The spraying of the green, which was 126 ft. square, took four hours, and 8 lb. of arsenic pentoxide were used.

The following were the main weeds present: Onehunga weed, parsley piert, hogcress, pearlwort, waxweed, slender chickweed, catsear, rib-grass, suckling clover, and clustered clover. Chewings fescue was the only grass of any consequence in the turf, and this was slowly weakening under the competition from the weeds and the continuous close mowing to which the grass was subjected. One month from the date of spraying scarcely a trace of weed could be found, while the Chewings fescue had thickened up and was being played on to the satisfaction of the bowlers. On 15th May of the present year the green was again visited. It was very nearly perfect from the bowler's point of view, and club members expressed satisfaction at the quick and inexpensive transformation of the green which had taken place, due to the spraying. The grass was somewhat weak after the season's play, but the amount of weed present was negligible. A trace only of Onehunga weed and parsley piert could be seen, and these plants were, without doubt, quite young, having come away from seed which germinated after the spraying.

At the Hokowhitu Golf-links two greens were sprayed with arsenic pentoxide on 6th March of this year. The spray at a strength of 1–60 was applied at the rate of 240 gallons per acre. In one case the approach was sprayed as well, making a total of nearly $\frac{1}{2}$ acre. The other green was about $\frac{1}{5}$ acre in area. Variations in soil-type, ranging from light sand to medium loam, accounted for fairly wide differences in the moisture content of the soil, a factor which affected in no small degree the final result of the spraying.

The lawn association prior to spraying consisted of Poa annua, brown-top, field-daisy, rib-grass, catsear, white clover, suckling clover, dandelion, slender chickweek, clustered clover, pearlwort, yarrow, Chewings fescue, Poa pratensis, parsley piert, and sorrel, in descending

order of dominance. Owing to the dry conditions at the time of spraying the grasses were not particularly vigorous. Where the soil was somewhat moister than on other portions of the green brown-top and the little Chewings fescue present made a quick recovery, while on all parts the percentage of weeds killed was high. On the extremely dry parts not only were all the weeds killed, but much of the grass as well.

A second spraying was necessary to kill those weeds which were missed or but lightly sprayed on the first occasion, due to the rather tall foliage preventing the even distribution of spray on all plants. The second application, which was made a week later, practically cleaned out all remaining weeds. Dandelion, yarrow, some white clover, and odd plants of rib-grass are now showing up and require local treatment. Yarrow and dandelion both require stronger solutions to kill.

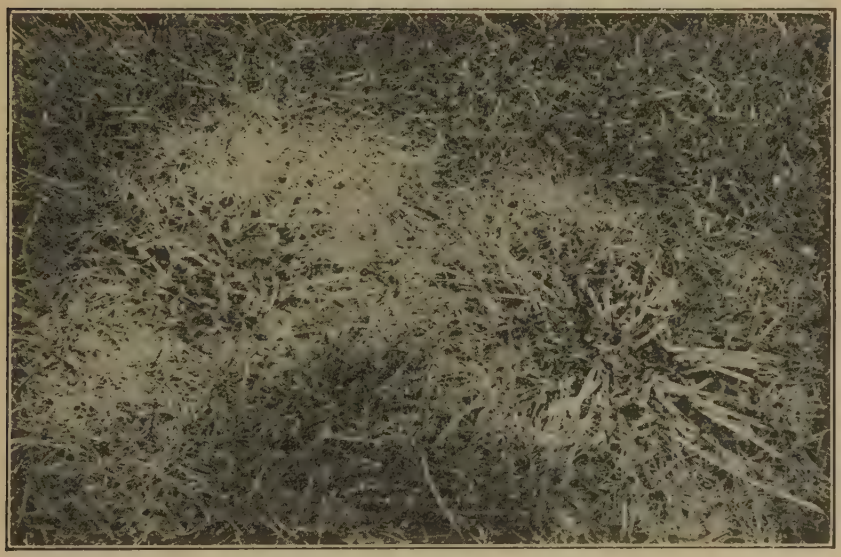


FIG. 11. KILL OF INDIVIDUAL OLD CATSEAR PLANTS BY LOCAL APPLICATION OF ARSENIC PENTOXIDE AT 1–40 STRENGTH.

At time of taking photo the grass of the lawn (brown-top) was spreading back into these areas bared by the destruction of the catsear.

[*Photo by E. Bruce Levy.*

The first spraying of both greens and the approach to one of them took two men, with a pump each, eight hours, and 24 lb. of arsenic were required. The second spraying took one man three hours, and 3 lb. of arsenic were used.

During the spring of 1930 an area at the Plant Research Station, Palmerston North, was sown down in brown-top plots, the seeding-rate being fairly light. A spraying trial was conducted to kill weeds that came in during period of establishment of these plots and to test out the spray method for subsequent control. The following fifty species of grasses, clovers, and weeds were present: Brown-top (two distinct

forms), creeping-bent, red-top, perennial rye-grass, Yorkshire fog, prairie-grass, Chewings fescue, white clover, suckling clover, clustered clover, haresfoot trefoil. Poa annua, cocksfoot, spotted burr clover, toothed burr clover, goat's rue, Scotch thistle, rib-grass, catsear, dock, sorrel, hawkweed, hogcress, slender chickweed, creeping speedwell, speedwell, timothy, black nightshade, chickweed, wire weed, smart weed, all-seed, sowthistle, catchfly, shepherd's purse, cudweed, woolly mullein, spurrey, scarlet pimpernel, greater plantain, fathen, loosestrife, stinkweed, groundsel, small soldier's button, parsley piert, cut-leaved cranesbill, storksbill, hedge mustard.

One portion of the area was treated with arsenic pentoxide at 1–60 and another at 1–80. The area sprayed was undulating, and the soil-types varied, but in each trial the results were similar in so much that about 95 per cent. of the weeds were killed. On the lighter soil and drier knolls some brown-top was killed in both cases, as well as all weeds. In the damper hollows no permanent damage was done to the brown-top, but virtually the whole of the weeds succumbed to the treatment. The solution of 1–60 was slightly more effective than the 1–80 in the damp hollows, but on the dry knolls the 1–80 killed the weeds as effectively as the 1–60 without injuring the grass to the same extent. It would appear from this that a weaker spray solution—say, 1–100—might have the desired effect on dry soils where the grasses are not strong and vigorous. All the white clover was not killed, as this was fairly tall and the spray solutions could not be made to come in contact with the stolons, from which the fresh growth soon made its appearance. The small percentage of weeds which recovered, other than white clover were docks, sorrel, and a trace of Scotch thistle and cut-leaved cranesbill. None of the grasses present, excepting Poa annua, were killed.

To test sodium chlorate ($NaClo_3$) against arsenic pentoxide, a lawn heavily infested with weeds but of an even association throughout was divided into two approximately equal parts. One portion was sprayed with 1–40 (2½-per-cent. solution) sodium chlorate, and the other with 1–80 arsenic pentoxide spray. The following weeds were the dominants of the lawn: Catsear, rib-grass, field-daisy, dandelion, Poa annua, pennyroyal, white clover, suckling clover, selfheal, moss, pearlwort, and yarrow. Among the grasses in the association brown-top and Chewings fescue were the dominants; some creeping-bent and Yorkshire fog also were present. The spraying of both areas of the lawn was done on 29th November, 1930, both solutions being applied at the rate of 240 gallons per acre. Approximately 90 per cent. of weeds were killed by each spray on the first application.

A second application was made on the 12th of the following month over both blocks, the spray being applied at the same rate per acre, but the strength of the arsenic pentoxide was increased from 1–80 to 1–60. A 2½-per-cent. solution of sodium chlorate was again used. Practically all weeds and clover were killed out by the two applications. Dandelion (Fig. 12) and yarrow resisted the spray, however, on both blocks.

Both treatments browned the green off entirely, but the effect of the arsenic pentoxide was much more rapid than in the case of sodium

chlorate. The green sprayed with the latter first took a yellowish-green colour for some weeks prior to browning off, and recovery of the grass was also much slower. At the time of writing practically all weeds are dead on both blocks, but much suckling clover is now showing up on the sodium-chlorate area, also much moss, due no doubt to the much longer period of bare ground that followed as a result of the more lasting deleterious effect of the sodium chlorate on the soil. The arsenic pentoxide area is virtually free of weeds, clover, and moss.

Several other spraying trials with arsenic pentoxide on private lawns have been carried out during the last eighteen months at Palmerston North. In all cases considerable cleaning-up of the weed content was effected, and where raking and reseeding followed the spray

FIG. 12. LAWN SPRAYED TWICE WITH ARSENIC PENTOXIDE, SHOWING THE TRUE DANDELION RESISTANT TO SPRAY.

For these resistant plants local application of arsenic pentoxide at strength 1–40 is necessary. The coarse grass on the right is Yorkshire fog, which entirely resisted the two sprayings. The finer foliage on the left is brown-top. [*Photo by E. Bruce Levy.*

treatment a marked improvement is shown in all lawns treated. One lawn—which was dominantly field-daisy, slender chick-weed, and pearlwort—required a second spraying three weeks after the first, and as a result of this later spraying 100 per cent. kill of all weeds was effected. The area was raked and seed was sown two weeks after the second spraying. A good even "take" proved that the harmful effect of the arsenic pentoxide did not remain long in the soil. This lawn, now eighteen months old, is almost perfect and practically free from weeds (Fig. 9). Brown-top is the dominant grass, while Chewings fescue is assisting greatly in forming a good close turf with the former grass.

Lists of Weeds and Grasses.

Following are lists of weeds referred to in this article, giving botanical names and whether susceptible or resistant to arsenic pentoxide spray :—

Weeds—Susceptible.

Allseed (*Polycarpon tetraphyllum*).
Black nightshade (*Solanum nigrum*).
Buttercup (*Ranunculus sardous*).
Catchfly (*Silene gallica*).
Catsear (*Hypochaeris radicata*).
Chickweed (*Stellaria media*).
Clustered clover (*Trifolium glomeratum*).
Cudweed (*Gnaphalium luteo-album*).
Cut-leaved cranesbill (*Geranium dissectum*).
Creeping buttercup (*Ranunculus repens*).
Creeping speedwell (*Veronica agrestis*).
Fathen (*Chenopodium album*).
Field-daisy (*Bellis perennis*).
Field-madder (*Sherardia arvensis*).
Goat's rue (*Galega officinalis*).
Greater plantain (*Plantago major*).
Groundsel (*Senecio vulgaris*).
Haresfoot trefoil (*Trifolium arvense*).
Hawkweed (*Crepis capillaris*).
Hedge mustard (*Sisymbrium officinale*).
Hogcress (*Coronopus didymus*).
Loosestrife (*Lythrum hyssopifolium*).
Moss (various species).
Onehunga weed (*Soliva anthemifolia*).
Oxalis (*Oxalis corniculatus*).
Parsley piert (*Alchemilla arvensis*).
Pearlwort (*Sagina procumbens*).
Pennyroyal (*Mentha Pulegium*).
Pennywort (*Hydrocotyle moschata*).
Poa annua.
Prickly sowthistle (*Sonchus asper*).
Ribgrass (*Plantago lanceolata*).
Scarlet pimpernel (*Anagallis arvensis*).
Scotch thistle (*Carduus lanceolatus*).
Selfheal (*Prunella vulgaris*).
Shepherd's purse (*Capsella bursa-pastoris*).
Slender chickweed (*Cerastium triviale*).
Sowthistle (*Sonchus oleraceus*).
Small soldier's button (*Cotula australis*).
Smart weed (*Polygonum Persicaria*).
Speedwell (*Veronica Buxbaumii*).
Spurrey (*Spergula arvensis*).
Spotted burr clover (*Medicago maculata*)
Stinkweed (*Gilia squarrosa*).
Storksbill (*Erodium cicutarium*).
Suckling clover (*Trifolium dubium*).
Toad-rush (*Juncus bufonius*).
Toothed burr clover (*Medicago denticulata*).
Wax weed (*Hydrocotyle novae-zealandiae*).
White clover (*Trifolium repens*).
Wire-weed (*Polygonum aviculare*).
Woolly mullein (*Verbascum Thapsus*).

Weeds—Resistant.

Dandelion (*Taraxacum officinalis*).
Dock (*Rumex* species).
Sorrel (*Rumex acetosella*).
Yarrow (*Achillea millefolium*).

Notes.—Dandelion is not common, and must not be confused with catsear, which is one of the most common of the rosette weeds in lawns.

Westport weed (*Cotula squalida*) : Up to the present the writers have had no experience with this weed.

Grasses—All resistant.

Brown-top (*Agrostis tenuis*).
Chewings fescue (*Festuca rubra* var. *fallax*).
Cocksfoot (*Dactylis glomerata*).
Creeping-bent (*Agrostis stolonifera*).
Crested dogstail (*Cynosurus cristatus*).
Perennial rye-grass (*Lolium perenne*).
Poa pratensis.
Prairie-grass (*Bromus unioloides*).
Red-top (*Agrostis palustris*).
Timothy (*Phleum pratense*).
Yorkshire fog (*Holcus lanatus*).

Conclusion.

The writers wish to stress that other chemicals beside arsenic pentoxide would serve quite well in the elimination of weeds by the kill-by-contact method. Proprietary arsenical weed-killers may be just as effective, but will no doubt be more expensive. Sodium chlorate is quite effective put on as a 2½-per-cent. solution spray (1 lb. sodium chlorate in 4 gallons of water) and applied at the rate of 240 gallons per acre. The disadvantages of sodium chlorate compared with arsenic pentoxide are that the recovery of the green is much

slower, and that sodium chlorate when reverted in the soil favours return of clover-growth unduly, the soil giving an alkaline reaction. Arsenic pentoxide predisposes the soil against rapid spread-back of clover, the soil giving, if anything, an acid reaction for some time after spraying. Arsenic-pentoxide treatment is about half the cost of sodium-chlorate treatment per acre of green.

There may be in existence, or possible of formulation by a chemist, a chemical spray that gives even a wider differentiation ratio of kill between grasses on the one hand and weeds and clover on the other hand than does arsenic pentoxide. The writers, as ecologists in the main, here seek to show the effect and purport of control of this ground-floor competition of weeds and clovers as a practical step towards lawn-improvement. Arsenic pentoxide is a good kill-by-contact weedicide, and is recommended as a convenient spray for the following reasons: (1) It is readily soluble in water; (2) it shows high differentiation in killing between grasses and the common weeds of lawns; (3) it rapidly reverts to a non-injurious compound, making possible early renewed growth of the existing turf or by reseeding; (4) the material is inexpensive and comparatively safe and easy to apply.

Up to the present commercial supplies of arsenic pentoxide have not been available in New Zealand, but a Wellington firm is now making importations.

THE UP-TO-DATE POTATO AND ITS VARIATIONS.

J. W. HADFIELD, Agronomist, Plant Research Station, Palmerston North.

PERHAPS no variety of potato has enjoyed such popularity in Britain and in New Zealand as the Up-to-date. Despite its susceptibility to leaf-roll in this country, and to wart disease in Britain, it still remains the ideal tuber. This is proved by the host of so-called new varieties indistinguishable from Up-to-date that have been placed on the market, nearly two hundred synonyms having been recorded since its introduction by A. Findlay in 1894.

In view of the high-quality stock seed of Up-to-date now being produced by the Department of Agriculture, its wider distribution and a revival of its popularity may be expected during the next few years. It is therefore opportune to warn growers that there are two distinct strains of the variety.

Growers of such a variety as Epicure will have observed strange plants appearing in a crop planted with pure seed. At first glance they appear to be rogues, but closer inspection will often puzzle the grower, for the differences are in *degree* of such factors as maturity, height, vigour, and flowering. Such plants are termed "bolters." The Up-to-date is a mid-season variety in which bolters occur. These are easily distinguished about flowering time, for they are taller, and more upright and vigorous. The flowers are more numerous and

TRUE UP-TO-DATE VARIETY ON LEFT; "BOLTER" TYPE OF UP-TO-DATE ON RIGHT. [*Photo by J. H. Claridge.*

conspicuous. The plants are very late and the yield heavy, yet, with all these differences, they would still be described by a potato-grower as Up-to-date.

Some growers have purposely or inadvertently selected the bolter type, so that we have entering for certification relatively pure lines of the true Up-to-date and also of its bolter type. Other lines, again, are a mixture of the two. So far we have made no distinction in certification between these types, but if experience proves that a distinction is desirable—and such evidence should come mainly from growers and merchants—we shall take action accordingly, for they are quite distinct in the date of maturity.

In New South Wales the Up-to-date is grown extensively under the name of "Factor," and a distinction is there made between Early and Late Factor, and an attempt is on foot to eliminate the "late," since it is reported to be quite unsuitable for the coastal conditions. In New Zealand a variety is on the market under the name of "Later Dates," and is said to be synonymous with the bolter from Up-to-date.

Opinions from growers and merchants would be appreciated. The accompanying illustration depicts the characteristics of the true and the bolter Up-to-date.

True Perennial Rye-grass and Californian Thistle.—At Makino, near Feilding, a series of plots sown with different strains of rye-grass extends over land which contains a considerable amount of Californian thistle, which seems to have been originally growing evenly over the whole area. In March last, sixteen months after the sowing of the rye-grass, it was noted that the Californian thistle was much less prominent on the plots sown with true perennial rye-grass, the more persistent vigorous competition of which apparently had checked greatly the growth of the thistle. A similar effect has been observed at the Marton Experimental Area.—*Fields Division.*

SOME ECONOMIC FACTORS AFFECTING APPLE PRODUCTION.

E. J. FAWCETT, Farm Economist, Department of Agriculture, Wellington.

AT the last annual conference of the Fruitgrowers' Federation a remit was presented asking the Department of Agriculture to undertake investigations into the economic position of apple-growing in New Zealand. An investigation of such a nature should be comprised of three parts:—

(1) A general survey of the organization of apple orchards.

(2) An accounting system introduced on a range of orchards in each district, such accounts to be so compiled that costing information may be extracted and the relevant value of varieties established in different districts. Costings must be so analysed that management may be studied, and improvements effected where any orchardist is producing at an unnecessarily high cost.

(3) Marketing facilities.

A PRELIMINARY SURVEY OF ORGANIZATION.

A commencement has been made with Part 1, and this article is a short summary of the salient features arising from a statistical analysis of the information collected. A total of 1,413 schedules were sent out to orchardists requesting certain information pertaining to the 1929–30 season. Of this total 553 schedules were returned, but owing to incomplete or unsuitable data and small numbers from some districts 320 had to be excluded from the analysis, which covers 233 orchards only. The records used have been grouped under the headings of Waitemata (Auckland), Hawke's Bay, Nelson, Mapua-Tasman, and Motueka.

The features of importance arising from this analysis may be treated as follows: (1) The average standard of production by districts; (2) the average standard of production by districts according to variety; (3) the maturity factor according to districts and varieties; (4) the effect of farm area on per-tree production; (5) the movement in planting or reworking programmes of different districts.

(1) AVERAGE STANDARD OF PRODUCTION BY DISTRICTS.

It is generally recognized that a wide range of per-tree production can be found in any district, and that individual orchardists may obtain highly paying crops irrespective of the general average. Management efficiency has its reward in orcharding as in any other branch of agriculture. The fact remains, however, that some districts have a higher potential production capacity per tree than others, and this is generally measured to a greater or lesser degree by the capital represented in orchards. It is possible for apple-farming to be as profitable in a district having a low average production as in one with a high average production, provided management is as efficient, and that the undertaking is capitalized at a level which compensates for reduced per-tree yields and for general overhead and working expenses, which must, on the average, be higher on a per-bushel basis where a greater

area and more trees are required to give the same total yield. This aspect of the industry is one which automatically falls into the second stage of the investigation—namely, costing.

Table 1 gives the average yield of all bearing trees contained in the schedules analysed, and clearly indicates the relative position of the five districts as grouped for this purpose. It must be remembered that the varieties enumerated in each district are not the same in all cases, some districts having a higher percentage of recognized high-producing varieties than others.

Table 1.—Average Yield per Tree over all Trees of Bearing-age (Five Years old and over), irrespective of Variety.

District.	Number of Orchards.	Number of Trees.	Bushels per Tree.
Waitemata	63	40,694	1·59
Hawke's Bay	68	38,285	4·38
Nelson	34	45,330	2·23
Mapua-Tasman	50	98,124	1·69
Motueka	18	20,332	2·32

(2) AVERAGE STANDARD OF PRODUCTION BY DISTRICTS, ACCORDING TO VARIETIES.

Although certain well-known varieties recur in all districts, there are several types which are more or less peculiar to individual localities. The incidence of varieties in any district is influenced by soil, climatic, and market conditions, but it is apparent from Table 2 that any variety gives a different response in different districts. The importance of a study of variety response to soil and climate cannot be overstressed. When taken in conjunction with marketing conditions and rate of maturity, it should form the basis of planting and reworking programmes.

Table 2.—Average Yield per Tree over all Trees of Bearing-age (Five Years old and over), according to Variety.

Variety.	Waitemata.	Hawke's Bay.	Nelson.	Mapua-Tasman.	Motueka.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
Sturmer	..	3·95	2·24	2·00	2·39
Delicious	1·49	5·10	2·47	1·57	1·94
Jonathan	1·04	3·91	2·47	1·92	2·35
Cox's Orange ..	0·82	2·30	1·89	0·74	2·12
Gravenstein	1·69	4·75	..	1·90	..
Dougherty	1·16	4·71	..	..	..
Ballarat	1·76	5·59	..	..	..
Dunn's Favourite ..	1·57	4·71	2·37	1·63	2·30
Statesman	..	4·80	3·40	1·83	2·52
Worcester Pearmain	..	..	..	1·04	..
Granny Smith ..	0·57	2·50	..	..	..
Rome Beauty ..	..	6·08	..	..	..
Others	1·79	4·27	1·71	2·06	2·63

(3) THE MATURITY FACTOR ACCORDING TO DISTRICTS AND VARIETIES.

The rapidity with which an apple-tree reaches maturity, as measured by yield, depends on variety, soil, climatic conditions, and management. The economic importance of the rate of maturity of any variety in any district depends upon the length of efficient bearing-life under average management conditions. It is apparent that a variety which normally reaches maximum production at, say, ten years of age and does not need reworking until thirty years is a more economic proposition than a variety which reaches maximum production at fifteen, but which requires reworking at thirty years of age. The same observation holds good so far as district influence on maturity is concerned. Although apparently apple-trees have a long life of economic bearing-capacity under highly efficient management, the average life under changing conditions of market requirements and the reorganization of orchards to meet those requirements tends to be comparatively low. Thus the ratio of full production period to the length of time taken to reach maturity has a very important bearing on the economic advantages or disadvantages of any particular variety or district.

In Table 3 an endeavour is made to indicate the existing position in the districts treated, dealing with six varieties which are of major importance in the localities concerned. The numbers dealt with in this table are insufficient to establish definite standards of maturity, but it is indicated that maturity is an important consideration which requires careful study.

Table 3.—Average Weighted Yield per Tree for Different Varieties in Different Districts, according to Age of Trees.

District.	Bushels per Tree, for Ages (Years).					Number of Trees concerned in each Group, for Ages (Years).				
	0–5.	5–7.	7–10.	10–15.	15 and over.	0–5.	5–7.	7–10.	10–15.	15 and over.
Delicious.										
Waitemata ..	..	0·58	0·89	1·22	2·60	..	1,048	1,136	7,234	845
Hawke's Bay	..	0·81	3·50	5·11	6·51	..	573	1,438	2,036	1,465
Mapua-Tasman	..	..	0·88	1·35	1·77	..	..	147	8,146	6,695
Motueka ..	..	..	..	0·93	2·29	..	..	..	291	2,627
Nelson ..	..	..	3·49	2·56	2·44	..	..	668	2,690	2,730
Sturmer.										
Hawke's Bay	..	0·86	3·27	4·80	3·19	..	531	911	3,825	2,133
Mapua-Tasman	..	..	..	2·09	2·09	..	..	..	8,371	14,559
Motueka ..	..	..	..	1·50	2·13	..	..	..	1,039	12,143
Nelson ..	..	..	2·45	2·55	2·32	..	..	59	3,690	7,679
Jonathan.										
Waitemata ..	..	0·48	0·99	0·98	1·37	..	63	177	1,136	210
Hawke's Bay	..	0·63	2·49	4·70	3·87	..	102	111	1,408	2,641
Mapua-Tasman	..	..	..	1·42	2·34	..	..	..	8,613	10,565
Motueka ..	..	..	..	2·84	2·13	..	..	..	2,156	3,499
Nelson ..	..	..	1·45	1·76	2·82	..	..	146	2,445	5,658

Table 3—continued.

District.	Bushels per Tree, for Ages (Years).					Number of Trees concerned in each Group, for Ages (Years).				
	0–5.	5–7.	7–10.	10–15.	15 and over.	0–5.	5–7.	7–10.	10–15.	15 and over.
Cox's Orange.										
Waitemata ..	..	0·81	0·55	0·50	0·80	..	175	113	112	50
Hawke's Bay	0·04	0·79	..	1·98	2·31	3,631	140	..	609	385
Mapua-Tasman	..	..	..	0·57	0·85	..	..	..	4,434	7,370
Motueka ..	..	..	..	..	2·12	..	..	..	..	1,462
Nelson ..	..	..	1·07	2·29	1·83	..	..	200	596	1,149
Dunn's Favourite.										
Waitemata ..	..	..	..	2·11	3·21	..	..	..	2,301	962
Hawke's Bay	..	..	..	6·73	5·14	..	..	..	171	579
Mapua-Tasman	..	..	..	1·62	1·66	..	..	..	3,965	5,532
Motueka ..	..	..	..	3·53	2·03	..	..	..	882	4,122
Nelson ..	..	..	..	2·04	2·50	..	..	..	813	2,151
Statesman.										
Hawke's Bay	..	..	..	6·33	5·81	..	..	..	100	153
Mapua-Tasman	..	..	..	2·34	2·45	..	..	..	1,114	558
Motueka ..	..	..	..	..	2·52	..	..	..	..	556
Nelson ..	..	..	..	4·39	2·87	..	..	..	319	542

(4) EFFECT OF ORCHARD AREA ON PER-TREE PRODUCTION.

In fruit-farming, as in every other branch of agriculture, the area of farms appear to have an effect on production. From the figures available, the Mapua-Tasman group provides sufficient instances to allow of an analysis on the basis of trees per orchard. The yield of trees fifteen years old and over has been taken, grouping being based on total trees on farms, irrespective of ages. For the five varieties, Jonathan, Sturmer, Dunn's, Delicious, and Cox's Orange, a definite trend in per-tree production is secured, showing that the production trend is comparatively stable for orchards having up to 2,250 trees; after this a sharp decline sets in, but production recovers again at 3,250 trees. Taking an average for all varieties, the yields are as follows:—

Table 4.—Average Yield per Tree according to Size of Orchard.

Range of Trees per Orchard.	Average Yield in Bushels per Tree.
500– 999	1·20
1,000–1,499	1·80
1,500–1,999	1·73
2,000–2,499	1·82
2,500–2,999	1·10
3,000–3,499	1·82
3,500 and over	1·58

The fact that all varieties show the same trend would suggest that the smaller yields for orchards between 2,250 and 3,250 trees are due to some difficulty in organization, probably connected with labour utilization. Again, a useful line of investigation is suggested to establish the economic-size units in relation to factors of management and labour.

(5) MOVEMENT OF PLANTING OR REWORKING PROGRAMMES IN DIFFERENT DISTRICTS.

In new plantings or when reworking trees it is natural that orchardists in different districts should have definite favourites. The choice of varieties may be influenced by personal opinion of market requirements, response of certain varieties in the district, or other causes. Outside of district peculiarities, the choice of new trees should be controlled by definite principles of yield, rate of maturity, and marketing conditions.

Although annual returns are made of new plantings, it is apparent that the number of trees reworked is of greater moment than new orchards, and under the present system of recording no indication is given of its extent. Table 5 illustrates the wide range of orchardists' choice in different districts, and if complete returns could be procured such information would enable the authorities to direct the planting or reworking policy of orchardists along lines based on proved facts.

Table 5.—Number of Trees of Non-bearing Age (up to 5 Years) of Different Varieties according to District.

Variety.	Waitemata.	Hawke's Bay.	Mapua-Tasman.	Motueka.	Nelson.
Sturmer	..	4,317	110	100	1,101
Delicious	1,898	1,582	12	20	12
Cox's Orange	827	3,657	873	..	729
Jonathan	123	409	50	50	377
Dougherty	30	70	..	..	..
Ballarat	641	795	..	..	..
Granny Smith	3,069	2,240	932	..	..
Gravenstein	97	573	448	..	..
Dunn's Favourite	711	214	..	..	..
Frimley Beauty	..	949	..	..	..
Statesman	..	806	1,118	8	534
Rome Beauty	..	381	..	..	..
Others	1,460 (48)	877 (50)	294 (29)	595 (20)	1,206 (30)
Percentage of total trees represented by non-bearing ages	17·9	30·6	3·8	3·7	8·0

NOTE.—The figures in brackets indicate the number of varieties represented by the term "others," and stress the diversity of choice.

This table also shows the trend in development in different districts, Hawke's Bay displaying the greatest activity, with Waitemata and Nelson following in that order. It is most desirable that this movement should be known, as it has a direct bearing on forecasting average production.

FURTHER INVESTIGATIONS.

In this short summary an endeavour has been made to show the type of information which can be derived from simple production data. It is unfortunate that only 233 records were suitable for use, as the reliability of any deductions made depends on the number of instances from which they are deduced, and the accuracy of the information used. It is hoped that these notes will illustrate the importance of such studies, as it is intended to submit schedules again at the end of June, asking for information relative to the current season. If a willing

and rapid response is forthcoming, the results of analysis will be available in time for use as a basis of crop estimation and estimations of exportable surplus for next season, which is one of the objects in collecting such information. Unless orchardists are willing to respond, however, the usefulness of any analysis made will be impaired.

Book-keeping.

A simple system of book-keeping suitable for orchards has now been completed, and a limited number of example forms is available. It is suggested that small groups should be formed in various centres, the members of such groups agreeing to keep records according to a definite system aiming at a uniform basis of costing which may eventually be applied to the problems of different districts. If such groups are formed, or if orchardists wish to discuss the project fully, the writer is prepared to meet them and go into details, so that a start may be made at the beginning of the coming season. It is suggested that any association interested should discuss the matter at an early date and communicate direct with this office.

The co-operation of all those who submitted information relative to last season's production is gratefully acknowledged, whether such information was suitable for inclusion in the analysis or not. Without the co-operation of growers nothing can be done.

The tabulation and analysis of the data on which this article is based was carried out by Mr. D. Viggers, of the Economics Section.

PIERIS RAPAE: A RECENTLY INTRODUCED CABBAGE PEST.

J. Muggeridge, B.Sc., Entomologist, Plant Research Station, Palmerston North.

Pieris (*Ganoris Pontia*) *rapae* L., is a species of butterfly, which is well known in many parts of the world as a pest of cruciferous plants. It was first noticed in New Zealand by Mr. E. S. West, at Napier, in 1930*, and his identification of the insect was verified by Mr. G. V. Hudson. At the time of writing the insect appears to be well established in the Dominion. How it reached this country is problematical, but it seems most likely that it was brought here in some ship's vegetable-chamber, in all probability from Hawaii. The following information gleaned from different sources should prove of interest and help in identifying and checking the spread of this pest.

The Adult.

The average expanse of wings is 50 mm. though a good deal of variation occurs. There is a distinctive sexual difference in colour and marking. The male (Fig. 1) is glaucous-white with grey to black markings. Dorsally there is a single black spot near the middle of each fore wing and a black spot on the costa of each hind wing. The female (Fig. 1) is creamy-white to yellow-buff, with grey to black

* *Ent. Mo. Mag.*, LXVI, 224.

markings. Dorsally there are two black spots on each of the fore wings and one black costal spot on each hind wing.

Egg, Larval, and Pupal Stages.

The eggs (Fig. 2), which measure from 0·9 mm. to 1 mm. from base to apex and 0·45 mm. at their widest diameters (about one-third of the distance from the top to the bottom), are just big enough to be seen, are shaped like a bullet, are deep yellow in colour

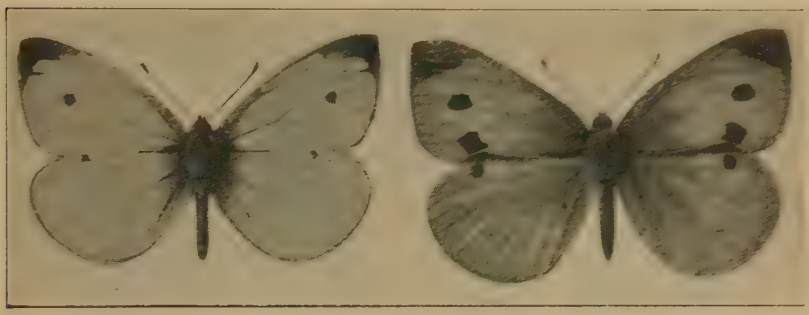


FIG. 1. LEFT—MALE; RIGHT—FEMALE. NATURAL SIZE.
After Frohawk.

FIG. 2. THE EGG, MAGNIFIED ABOUT 45 TIMES.
After Frohawk.

and have ridges running both lengthwise and crosswise. They are glued singly to either side of the leaf, but generally are to be found on the under-surface. They hatch in from three to five days, according to temperature conditions prevailing. In all several hundred are laid by a single female.

Shortly after hatching the young larva commences feeding on the plant-tissue and eats out small areas on the under leaf-surface. Prior to moulting in any stage it attaches itself to the leaf with a few threads. There are five moults, and hence five larval stages (Fig. 3 *a* to *e*). The adult larva is an intense leaf-green, except for a slender orange stripe down the middle of the back, and another broken stripe along each side of the body, which is formed by a pair of elongate yellowish spots near each spiracle. The caterpillar has a velvety appearance, due to numerous close-set, short, white and black hairs that form a kind of white bloom over the body. When full-grown

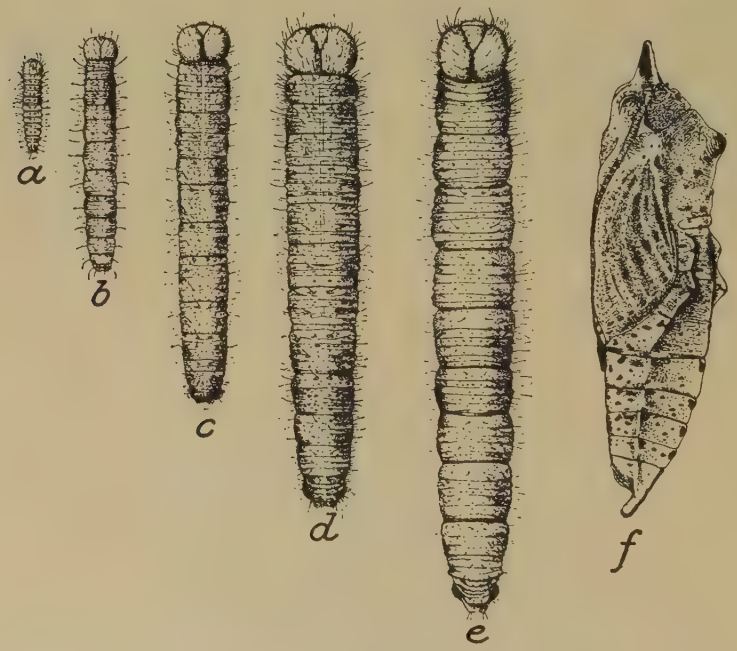


FIG. 3. THE DIFFERENT LARVAL STAGES (*a* TO *e*); THE PUPA (*f*). ALL MAGNIFIED.
[*From Wisconsin Agr. Exp. Sta. Res. Bull. 45.*

the larva hunts for a favourable place to pupate, and, though many may pupate on the host plant, the majority apparently are found on adjoining fences, buildings, or trees.

The pupa (Fig. 3 *f*) measures 19 mm. long. The head is beaked in front, and the thorax strongly angulated by a central dorsal keel which rises acutely at the middle and declines to the abdomen; it then again rises gently and curves to the anal segment, terminating in a long cremaster furnished with hooks. The colouring varies considerably, though it usually harmonizes with its surroundings, being highly sensitive to backgrounds.

Seasonal History.

The time occupied in completing the life-cycle of this insect apparently varies considerably according to climatic conditions. In the northern part of the United States only three generations a year normally occur, whereas in the southern States up to six generations have been recorded. It would appear, therefore, that, while the insect hibernates as a pupa during the winter months, it would be quite capable of continuous development if climatic conditions were

FIG. 4. LARVÆ FEEDING ON CABBAGE-LEAF.
[*From Conn. Agr. Exp. Sta. Bull. 190.*

favourable. The number of generations a year possible in New Zealand, therefore, will no doubt vary a good deal according to locality, but this can only be determined by observation.

Hosts.

Following is a list of some of the food plants of *Pieris rapae* recorded by various writers: Cabbage, cauliflower, radish, horse-radish, mustard, mignonette, nasturtium, water-cress, shepherd's purse, sweet alyssium, stink-weed, and lettuce. Of these, cabbages and cauliflowers are the preferred food plants.

Injury to Plants.

Injury to plants consists in the indiscriminate destruction of leaf-tissue (Fig. 4). In the case of cabbages and cauliflowers the leaves are severely skeletonized—in fact, the injury to or destruction of these plants differs very little from that of the diamond-back moth, so common throughout this country. With mature cabbages damage is caused by the larvæ tunnelling into the heads, and the green castings which the worms leave behind them give the plants an unsightly appearance and renders them unfit for consumption.

Control by Sprays.

Fortunately *Pieris rapae* is readily controlled by the use of arsenicals, and the following practices and spray formulas have been recommended for use by workers in the United States :—

(1) All plants should be dipped in a solution of calcium or lead arsenate, 1 lb. to 50 gallons of water plus 1 lb. of laundry soap, at the time of setting out in the field.

(2) Arsenate of lead or calcium arsenate in powder form should be used at the rate of 1 lb. to 50 gallons of water plus 1 lb. of common laundry soap. Paste forms of the arsenicals should be used at the rate of 2 lb. to 50 gallons.

(3) Paris green may be used at the rate of $\frac{3}{4}$ lb. to 50 gallons of water plus 1 lb. laundry soap.

The number of spray applications necessary will probably be best determined by observation, and further sprayings should be made when injury is becoming noticeable. Spraying may be safely carried on up to within four or five weeks of harvesting the vegetable.

Biological Control.

There seems little doubt that biological factors are capable of exercising a considerable amount of control of *Pieris rapae*. The two most important parasites are *Pteromalus puparum* L. and *Apanteles glomeratus* L., both of which are regarded as being of considerable value in the United States, *P. puparum* being particularly useful in the northern States. Parasitization by both of these insects in the United States varies for the different generations. Though not numerous in the spring, they increase rapidly through the summer months, giving from 60 per cent. to 80 per cent. control as the season advances. Numerous other parasites and predators have been recorded, but the most efficient natural enemies appear to be those already referred to. Mention may also be made of a contagious bacterial disease—*Micrococcus pieridis*—referred to by some writers as Flacherie or "wilt," which in some seasons destroys large numbers of the larvæ.

The writer wishes to thank Mr. G. V. Hudson, of Karori, Wellington, for helpful suggestions in the preparation of this article.

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A METHOD TO OBTAIN DRY-ROT-INFECTED SWEDE SEED.

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EXPERIMENTAL work on the disinfection of swede seed from dry-rot (*Phoma lingam*) has been greatly hampered by the lack of a highly infected line of seed for use as experimental material. Seed produced even from a crop in which practically every plant showed dry-rot lesions carried only a fraction of a percentage of infected seeds. Tests for complete disinfection of such a line, therefore, entailed an amount of culture work beyond the capacity of this Laboratory in staff and equipment.

Artificial infection of the seed heads by spraying with a suspension of *Phoma lingam* spores proved unsatisfactory when done in the open field, but it was found that a fairly high percentage of infected seed could be obtained by direct injection of the inoculum into the developing seed-pods by means of a hypodermic needle. Two pure strains of *Phoma lingam* were used: Strain IIA—taken from seed, bulbs, and leaves of swedes; and Strain IIB—a particularly pathogenic strain isolated from swede seed. A strong suspension of these strains was prepared by macerating sporulating cultures in distilled water. This was filtered through cheese-cloth and the resulting suspension injected by means of a hypodermic needle syringe directly into the almost fully developed, but still green and fleshy, seed-pods. With both strains, practically 100 per cent. of the pods developed dry-rot lesions at the point of inoculation.

The seed heads were ripened and threshed in the usual manner, and the resultant seed freed from extraneous matter by careful sieving. Germination tests showed this seed to be of slightly below normal vigour. When plated on nutrient agar the seed from the two strains gave the following results: Seed inoculated with Strain IIA—An average of twenty-six colonies developed from each 100 seeds = 26 per cent. Seed inoculated with Strain IIB—An average of 16·4 colonies developed from each 100 seeds = 16·4 per cent. In every case seed from plants inoculated with Strain IIA yielded Strain IIA only, and that from IIB inoculated plants IIB only.

The limited quantity of seed thus obtained has already been almost entirely used in further disinfection experiments, but the method having proved successful, preparations are in hand for the production of a much larger quantity next season.

Jöhne's Disease.—By an Order in Council recently gazetted Jöhne's disease was declared to be a disease for the purposes of the Stock Act. This trouble, which is practically confined to cattle, is also known as chronic bacterial enteritis.

Correction.—Referring to the article, "The Official Seed-testing Station," in the *Journal* for April last, on page 256, Table 14, the figures of imports of rye-grass, Timothy, and Poa pratensis should be transferred to read as follows: Rye-grass, 4,347 cwt., £6,100; Timothy, 2,351 cwt., £4,775; Poa pratensis, 201 cwt., £1,130.

SEASONAL NOTES.

THE FARM.

Pasture Considerations.

A VALUABLE criterion of the management of pastures which have been established for some years is often provided by the appearance of the fields in winter: a healthy green colour then is indicative of good nutrition, of effective drainage, and of palatable, digestible, and rich herbage. It also suggests that the cultivation and grazing has been of a nature which has freed the land of matted sward and coarse vegetation. In general, when winter pastures are not of a healthy green colour it is quite possible that this is due to some weakness which could profitably be remedied. Hence the winter is a most useful season in which to make a review of the status of the different pastures of a farm.

Apart from colour, any tendency to change in the composition of the pastures is of moment. Increased prominence and spread of perennial rye-grass may be taken as evidence of all-the-year-round improvement in the pasture. Conversely, a gradual decrease in perennial rye-grass may be taken as a sign of falling fertility, or bad grazing-management, or, as is more probable, a combination of both of these factors. But it is well to remember that a sudden falling-off in the rye-grass content of a pasture, as frequently happens in the case of young grass, is not at all necessarily the result of too low fertility or bad grazing. Indeed, it is more than likely to be the result of the use of an inferior type of rye-grass seed. Great prominence of white clover, and the rapid replacement in young pastures of rye-grass by such weeds as sorrel, are also at times due to the same cause. The only way of avoiding such inefficient results is the use of true perennial rye-grass.

Before any land is condemned to the permanent production of an inferior sward it is advisable to explore well the possibilities of making the land carry profitably a superior sward containing a mixture of rye-grass, clover, cocksfoot, and dogstail. In some ways winter is an excellent season for exploring such possibilities. Badly drained conditions, which speedily drive out the better species of pasture plants, can be readily detected. If drainage is good and yet any rye-grass present is not thriving, then top-dressing may be expected to be well worth while. In many cases the shortest and most profitable route to an improved permanent pasture will be through the plough, provided the conditions that induced the inferiority of the pastures that are to be broken up are remedied. When a paddock is to be broken up primarily for the purpose of sowing it down in seed which will give an improved sward it is well to remember that the mere sowing of seed fitted to give a good pasture will not necessarily give that pasture. If such practices as top-dressing and drainage are needed, then until they receive attention the sowing of good seed will be more or less futile.

This should be kept firmly in mind in planning permanent pasture improvement, for sometimes ignoring of it leads to considerable difficulty. For instance, at times when a sward inferior on account of plant-food deficiency is broken up crops which impoverish the soil are grown before any attempt is made to sow the land down in grass again. In such a case one cannot reasonably expect an improved permanent pasture until the plant-food supply is made better than it was prior to the impoverishment by the exhausting crops. With permanent pasture, fully nourished growth

from the start is of so much moment that as far as possible any cropping prior to the sowing of such pastures should tend to build up rather than to deplete soil-fertility. To some this may appear obvious, but that the rule it lays down is frequently broken in practice becomes clear from the fact that such crops as oats, maize, and millet, which at times precede grass, all tend to reduce fertility, especially when they are not consumed where they are grown. Under particular circumstances in the past it was accepted as good practice to lay land down in pasture only when it had become so worn-out and possibly weed-infested that it would no longer profitably grow other crops, and even to-day the influence of the old idea, which rightly has been widely discarded, makes itself felt detrimentally.

Top-dressing, Harrowing, and Spelling of Pastures.

In many districts top-dressing may be carried out in July with good results. Where, as so often is the case, it is desired to stimulate growth rapidly, then ordinarily superphosphate should be used. Further information has been given in these notes in recent months. If there is the prospect of a feed shortage during August and September, then top-dressing about mid-July with sulphate of ammonia may at times be resorted to with profit. For this purpose well-drained fields carrying a good deal of rye-grass should be selected if possible. Coarse, dry herbage should be removed from them by suitable close even grazing, and they should be harrowed prior to the application of sulphate of ammonia, which usually is best applied in conjunction with superphosphate or in the form of ammoniated superphosphate.

Usually July brings its quota of grass-harrowing even though considerable harrowing has been done earlier. Harrowing of fields which have been stocked heavily in May and June is particularly desirable. Harrowing is also particularly useful on fields still carrying coarse or matted growth as a legacy from unchecked matured growth in the autumn.

When available, well-drained, well-sheltered paddocks should be closed in July for the use later on of early calving or early lambing stock. Rye-grass is of particular value in such paddocks, because of its ability to provide fresh leafy growth in the early season.

Winter poaching of wet, soft paddocks at times causes substantial permanent damage. Young pastures are particularly prone to suffer because of poaching. Pastures deteriorate on account of excessive trampling, because of the burial and loss of valuable plants, and because of the creation of bare surface patches of soil on which weeds, such as thistles, rushes, buttercups, and daisies establish themselves, whereas with an unbroken sward their establishment would be impossible because of the competition of the useful pasture species. Heavy types of soil are most subject to serious damage through poaching. The practical course is to avoid as far as possible the stocking of those portions of the farm which are most subject to poaching damage.

Tile Drainage.

Brief guidance in regard to mole drainage was given in these notes last month. Probably tile-drainage work is on the whole more efficiently done than mole-drainage work, but at times by giving attention to certain points more effective work would result. It is, for instance, always advisable when at all possible to carry out tile drainage when the land is in grass. Then all the sods of turf may be placed by themselves on one side and the remainder of the spoil on the other side. In filling the ditch the sods should be placed on the joints of the tiles with the turf down, and sods should be used at the mouths of any moles which discharge into the tiles. When making tile drains in cultivated land it is advisable, in the absence of sods, to use clippings from gorse and other hedges.

A minimum diameter of 3 in. in tiles, with larger tiles for main drains, may well be adopted. It is preferable not to lay tiles until the ditch has been cleaned of any silty material by a heavy rain, but after the tiles have been placed in position the ditch should be filled in as soon as possible. The bottom of the ditch should as far as possible fit the diameter of the tile being used, as a good fit in this respect prevents rolling. To assist in avoiding displacement of tiles by the settling of earth, the bottom of the ditch should be rounded. In laying tiles it is particularly necessary to make them fit at the top; openings at the joints on the lower side need not cause concern. It is usually courting disaster to lay tiles on an unstable bottom, which calls for the use of box drains. The only time collars in tiles are needed is when the drain-line is in the vicinity of a hedge or trees. The collars then prevent root penetration and blocking of the drain. Branch tile drains should not be at right angles to main drains.

Other Drainage Work.

In winter, apart from the installation of new drains, there is frequently other drainage-work needing attention. Too often the outlets of drains are allowed to remain choked, with great resultant loss in efficiency. Open drains should be kept clear, particularly if other drains discharge into them. All indications of failure of drains or want of drainage should be carefully noted, the former with the object of removing any obstructions, and the latter with the object of being able to do the work most efficiently when it is undertaken.

Winter Feeding of Stock.

At this season it may fittingly be emphasized that poor winter feeding of stock is one of the common and most grievous weaknesses of New Zealand farming. The feeding of the developing dairy heifer, unfortunately, often falls far short of the needs of the animal. A direct result is stunting of growth, which also may be expressed as loss of full inherent size, and which is known to have a harmful effect on yield. In the winter feeding of dairy heifers the use of straw and very poor hay should be avoided. These materials are difficult to digest. All the nutriment that is obtainable from them is needed to keep the animal alive, and nothing is available to enable it to grow, irrespective of how much of such material is given. Actual starvation brings death, but the consumption of very coarse feeds enables animals to survive barely, and it is this latter condition that generally leads to stunting of growth. It is specially advisable to feed well heifers which come to their first calving at an abnormally early date. It frequently happens that stock which are going through their first winter, and which previously have been treated well, are fed on material such as straw and hay, which is ample in quantity but deficient in quality. Such stock, both males and females, are so apt to suffer permanently that they really should be given the best fare that is available—for example, a ration comprising a mixture of roots and good hay to supplement any available leafy pasture-growth, or good silage to supplement the pastures.

Roots and silage may be classed generally as somewhat watery bulky feeds, and so it is better to feed roots and hay than rations of roots alone or roots and silage. Silage alone has at times been used as a winter supplement to pastures with good results, even when very little feed was obtainable from the pastures, but the prolonged feeding of roots alone is likely to lead to such disorders as redwater. Whether better results are obtained from silage by using it alone or in conjunction with hay in the winter seems to be an open question. Probably much would depend on the respective qualities of the hay and silage. It

is at least certain that a number of successful farmers feed silage alone, especially round calving-time, and claim that they thus have less calving troubles than if they had substituted hay for the silage. In a similar successful manner silage has been fed to ewes right up to lambing-time.

Cereals sown in the autumn should be fed-off before growth becomes too long. As a rule two feedings of relatively short growth are preferable to a single feeding-off of long heavy growth, in which considerable waste is almost certain to occur. The feeding of roots calls for widespread attention. After swedes, carrots and mangels should be fed in the order named; the mangels may be kept to the last because of their exceptionally good keeping qualities. Chou moellier is generally in good condition for feeding in July and should be used then, for sometimes in August it exhibits a tendency to run to seed-stalks.

General Crop Considerations.

It is now necessary to decide without much delay what crops other than grass are to be grown during the coming season. At times it seems that the area under special crops is reduced to an undesirable extent because consideration is given to estimates of crop production which are quite misleading. The point of importance is that general statements as to cost of crop production, if they profess to cover all operations, are in practice necessarily misleading in a great number of instances because so few farms replicate exactly, in all importants respects, the so-called "average" farm to which the estimates in theory apply. Indeed, the real cost of growing special crops usually cannot be determined accurately in respect to a particular farm, and it is in such circumstances not reasonable to expect greater accuracy when a number of farms are grouped for consideration.

On a strict economic basis the cost of special crops is usually considerable. But much of this cost is on account of work done by the labour ordinarily employed, and with equipment already provided, independently of the special crop. Such expenditure would be incurred whether or not the special crop is grown. Hence the practical question is largely one of alternative utilization of such labour and equipment. If the special crop were eliminated, could the labour and equipment be employed in another more remunerative way? Each farmer must answer this question for himself, taking into account his particular circumstances. In brief, the farmer should concern himself not so much with the true economic cost of a special crop, but he should ask himself what will be the direct outlay incurred, to what extent the growing of the crop will interfere with any other farm work, to what extent the special crop is required as part of any scheme of farm-development, and what is the value of the special crop to the farm stock. These two latter considerations are apt to be of special moment. For instance, it may be advisable for one farmer to grow roots for winter feed, while it is advisable for his next-door neighbour to resort to ensilage for the same purpose; the pastures of the former would need improvement by way of the plough, the pastures of the latter would have been improved already.

Enough has been said to indicate that the question of special crops cannot be decided upon the basis of cost alone. It is, indeed, ordinarily a complicated question, which cannot be answered lightly. It is one in which it is unsafe to follow the lead of neighbours—it might be the proper course for one man to discard the use of the plough, whereas it would be inadvisable for his neighbour to do so—so much may depend on the condition of the pastures and the labour position on each farm. One outstanding fact bears on the position—the feed-supply during the off-seasons of grass-growth is in many cases inadequate, and in a substantial number of these cases the growing of

special crops would very profitably remedy the position. In this connection two crops that certainly deserve more attention are lucerne and mangels. Frequently preparatory cultivation for these crops should be commenced at an early date if it has not already been commenced.

Lucerne.

Lucerne has been grown successfully for many years over a wide range of conditions in New Zealand, so that a considerable amount of local experience has been accumulated. This shows that lucerne is not at all as exacting in its requirements as some seem to believe, and that it can be grown on practically all types of naturally well-drained soils. Deep, open, fertile soils are undoubtedly best for lucerne, which does not thrive unless both surface drainage and under-drainage are good. Young lucerne is not capable of battling well against weeds—a fact which should be remembered in selecting and preparing land for lucerne. If lucerne is to follow old pasture, the land should be skim-ploughed well ahead of the time of seeding and ploughed deeply only once, so that weed seeds occurring in the surface soil may be buried so deeply that they will remain dormant, provided they are not brought to the surface again by further deep tillage. Land which has been under the plough should be sown in lucerne only if it has been kept "clean" while in the arable condition, either by fallowing or by the growing of fallow crops, such as mangels or potatoes, which have really cleaned the ground, or by the growing of smothering crops such as oats and tares which weaken weeds.

Further information regarding lucerne management will be published in the near future.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Hints on Pruning.

ANOTHER season of effort and reward in the orchard has passed with the harvesting and marketing of the late varieties of apples and pears, leaving the commercial fruitgrower a short period for rest and recreation prior to renewing the preparatory activities for another crop. During the months which comprise the dormant season pruning represents the most important operation in the orchard. The results of pruning may be described either as misdirected effort or sound investment; so far reaching are they in effect that the influence may be beneficial or detrimental to the whole life of the orchard treated. The details of the art of pruning are many, and cannot be dealt with effectively in these notes, which will be confined to the objects plus a few sound recommendations.

The object of pruning a deciduous fruit-tree in the early stages of its growth is to create, stimulate, and train a system of branches suitable for carrying maximum crops of fruit, to expose the bearing-parts of such a system to the best influences of light and sunshine, resulting in the stimulation of fruit-bearing wood and the enhancement of the fruit produced. A few suggestions toward this objective may be of service to readers. Assuming that the tree is making normal growth, the operator should not hesitate to prune hard until the third year after planting, by which period all the leaders or main branches should be formed from low down on the trunk of the tree. This is necessary in order to avoid duplications of branches high up in the tree, which

would tend to place the weight of crop on the extremities of the branches, leading to undue leverage and breakage of main limbs. Having realized the requisite number of permanent limbs, a system of gradual lengthening of the annual cut-back should be commenced until the vigour of the tree becomes retarded by the increasing crop.

The crop should commence to form naturally on the weaker laterals left to mature and for fruit-buds, overstrong laterals having been removed when formed, to be replaced by laterals of a weaker type which grow from the basal buds of the strong laterals the season succeeding their removal. These weak laterals should be left undisturbed until fruit has been borne, when it becomes necessary to cut in order to stimulate and encourage growth of the terminals to nourish the fruit-buds formed on the lateral.

Abnormally Vigorous Trees.—This condition often causes concern to the grower, more particularly with certain varieties of pears and Japanese plums growing on strong ground. There are differences of opinion regarding the best means of overcoming this undesirable condition, some advocating such drastic remedies as severe root-pruning and summer pruning. The writer's experience tends to recommend very light pruning in the nature of thinning out, with careful avoidance of shortening-back of extensions; or the relinquishment of pruning entirely until the tree has formed sufficient crop to retard its growth. The latter method is certainly more natural to the tree, and avoids the drawbacks associated with the former methods, such as root-cankers and bacterial infection, often experienced in conjunction with root-pruning; while unseasonal and unripe growth frequently results from summer pruning, together with uncertain results which are largely determined by the climatic conditions immediately following such pruning.

Debilitated Trees.—Trees of this type are often a matter of concern to commercial fruitgrowers, the trees having arrived at a stage when little or no extension of annual growth takes place, and when the fruit is small and the amount produced unprofitable. There are two avenues open to the fruitgrower to correct this condition—namely, special consideration with regard to the application of fertilizers, and relief of crop for a period.

If the condition has become extreme both factors should be brought into practice. If the condition is not pronounced liberal applications of nitrogenous manures will stimulate leaf-growth, and the tree will naturally assimilate more plant nutrients, which will be reflected in a renewal of annual extensions and an increase in size of fruit. Limitation of crop or its entire removal has a very considerable effect on debilitated trees, which are generally trees which have been subject to overcropping and depleted nourishment.

General Recommendations.—It should be remembered that apples, pears, and European plums produce fruit on two-year-old wood and over, while peaches and nectarines bear fruit on one-year-old wood only; wood over this age becoming barren. Japanese plums bear fruit on wood one year old and over. When pruning, the operator should carefully observe the effects of the previous season's cutting, and continue or make adjustments accordingly.

—M. Davey, Orchard Instructor, Mapua, Nelson.

Citrus Culture.

In last month's notes some suggestions were put forward indicating how growers could in a measure prevent frost damage by the use of artificial heat. If it is not possible to carry out the recommendations made, it will be a good plan to fill up all gaps in the shelter-belts, and to deflect rather than encourage by ready passage the frost currents which usually pass through such gaps. In the event of any damage to the tips of the growth these damaged portions should not be cut out until the danger of frost is past.

The season for harvesting Poorman oranges is now approaching. Several pickings are required, as all the fruit is not ready to be gathered at the same time. No fruits should be picked until the green colour has changed to a shade of yellow. A pronounced wilting will take place if the fruit is gathered too soon. The fruit from the time it is gathered should be handled carefully, in order to prevent undue damage from bruises and skin punctures, which rapidly lead to decay. Stored fruit should be checked over frequently, as decay is more prevalent than where the fruits are gathered under dryer conditions.

Conditions favouring the development of citrus brown-rot may have to be contended with. It may not be altogether possible to prevent this disease, but a good deal can be done that will prevent it becoming general. Providing previous instructions have been carried out, such as removing the lower branches that are touching the soil, and the usual sprayings carried out for verrucosis with bordeaux mixture, the trees and fruit will not be so liable to be attacked. However, it may be a wise precaution to give the trees a further spraying of bordeaux 4-4-40, taking particular care to cover the portions of the tree nearest the soil.

Nothing can be done at this season of the year in regard to cultivation, but every precaution should be taken to provide adequate drainage for all surface water.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Mating the Breeding-stock.

It may be well to again remind poultry-keepers that August and September are the best months in which to have the chicks hatching out, and therefore no time should be lost in mating the parents of next season's young stock. The early-hatched bird is invariably the most profitable, for it is bred at a time when it has to be protected from harsh weather, and passes through its most critical stage of development before the advent of the hot and trying months.

The mating of birds demands great care on the part of the breeder if satisfactory progeny is to be produced. It is not always possible to bring together birds which will nick with each other, but the breeder can certainly bring about some improvement in type in the process of mating by using a female which is strong where the male is weak, or *vice versa*. Few of the types which will have any influence in raising the standard are to be found in the best flocks in the country, and therefore the greatest care should be taken in selecting the breeding-pens, and mating them in such a way that weaknesses will be reduced rather than be increased. It is taken for granted that only purebred birds are used in the breeding-pen. As previously indicated, even under the most favourable circumstances it is not always possible to secure the desired stock of a type which might naturally be expected from a particular breeding-pen, but the disappointments are multiplied when crossbreeding is resorted to. It is admitted that a first cross is often productive of very satisfactory laying stock, but if these grades are bred from disappointment is bound to be experienced.

The poultry-keeper who is keenly intent on raising the productive characters of his flock and thereby making poultry-keeping the payable business it should be will appreciate the necessity for taking the greatest care in mating-up the breeding-pens, and especially in seeing that only the most desirable birds are used. In previous issues of the *Journal* particulars have been published of the desired type of hen to breed from, and while the female should be as good as possible, equal care should be taken in selecting the male bird. Feminine characters should be looked for only in

a female; the male should be practically the other extreme, though coarseness is not necessarily an indication of breeding-power.

Selecting Cockerels for Breeding.

An inquirer who has a number of White Leghorn cockerels asks for some definite signs which will enable him to select the best four for future breeding-purposes. This is not so simple a mattter as it appears on the surface. There are certainly outward signs which indicate breeding-power, but it is only the person with an experienced eye who can well discriminate between the good and bad points in the general make-up of a bird.

The first thing to look for is signs indicating strong constitutional vigour. This is essential for many reasons, the principal of which may be briefly enumerated. Constitution is necessary if the type is to be perpetuated—that is, if the bird is to have the desired prepotency and if the female progeny are to have the power to digest and assimilate a large quantity of food, which is imperative if a maximum egg-yield is to be secured. Heavy egg-production entails a heavy strain on a bird's reproductive organs, and if its vigour is not preserved there must necessarily be a rapid decline in egg-yield and a grave risk of the bird falling an easy prey to disease germs and parasitic infestation. Should a bird of strong constitution have some little breed defect this can be corrected in the mating; but if the bird selected is the best on utility and breed points, but is weak in constitution, all these advantages will be lost by its failure to pass on its desirable characteristics to the offspring.

Regarding indications of constitution, there is no better guide than noting a bird which is the most spirited in action, possessing a bold prominent eye, a stout well-curved beak, a well-balanced frame carried in a proud manner, and standing on strong flat-boned legs set wide apart, with good chest development, wide across the back, and having tightly feathered plumage. A bird possessing these sure indications of constitution will often show fight even when a human being approaches it. Obviously it is the most virile and is therefore the strongest sire. Such birds are usually the bosses of the yard, even when penned only with cockerels. It must not be inferred that a bird should necessarily display what might be termed viciousness for it to have the desired constitution. It is, however, true that a pugnacious temperament is seldom or never found in other than a highly strung vigorous bird.

It does not necessarily follow that because a bird possesses maximum points indicating constitutional vigour he will necessarily make a high-class sire where high egg-production is the chief object aimed at. Constitution should certainly be given the first consideration, but laying-type, desired size, happily combined with breed points, and a knowledge of his ancestors must also be taken into account. In aiming at developing the egg-producing power all the above-mentioned characters must be taken into consideration when selecting a male to head a breeding-pen—that is to say, if desirable characters are to be intensified and produced from one generation to another. Many utility-poultry keepers contend that if a male is bred from a heavy producing mother he must necessarily be a desirable sire. This is a mistake, for breeding from birds on egg-yielding performance alone may easily lead to producing birds of all shapes and sizes, which in the long-run would have nothing to recommend them from a useful standpoint. The writer fully appreciates the value of productive performance, which is the best guide we have to egg-laying power, but the mere ability to produce a certain number of eggs in the season is not everything. For the building-up and maintenance of a uniform laying strain type must be the main consideration, and type in which indications of laying characters are happily blended with constitutional points in both the male and the female.

When practical experience of breeding utility poultry is more extended, the recognition of an absolutely definite type will be an acknowledged truth. The question will never be settled theoretically. Of course there are exceptions to every rule, and it is not uncommon to find a bird of almost ideal type but which owing to his being undersized for his breed would be discarded by the practical breeder. Extreme size should not be aimed at, but rather the breeding of birds conforming to the weight clauses in the New Zealand Utility-poultry Standards. Considering the types illustrated in these standards and the general requirements of the ideals aimed at, there is nothing antagonistic to the best utility type and the possession of the necessary stamina.

While the fancier often makes the mistake (especially with certain breeds) in breeding for exceptional size, the utility breeder in too many cases makes an equally serious error in breeding from undersized stock which in no way conform to standard weight requirements. In both cases the best interests of the breeds are being ignored. A happy medium must be the objective. The point need hardly be emphasized that in breeding from heavy-producing stock there is always a tendency for the progeny to rapidly decline in weight, however well they may be fed and managed, and that therefore an undersized male of its breed should never be bred from if it is possible to avoid doing so.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Winter Inspection.

THE management of the apiary at this season consists chiefly in making an occasional round among the bees to see whether anything has gone wrong with them. On no account should they be unnecessarily meddled with. Where any doubt exists as to the stores required for wintering it may be necessary to open the hives. However, it is by far the better practice to try and estimate the quantity of stores on hand by lifting the back of the hives. Experienced beekeepers can in this way gauge by weight the stores present. Inexperienced beekeepers will, of course, have to examine the combs. If it is necessary to do so, choose a fine day, and in any manipulation that follows on no account break up the cluster of bees. After examination, close up the colony as soon as possible in order to conserve the heat.

Should a colony be found deficient of stores, a comb or two of honey or a cake of candy laid on top of the frames over the cluster will help considerably. At this season of the year bees will not take syrup readily. If combs of honey are on hand and feeding is carried out, place the combs on the outside of the cluster. To place them in the centre of the cluster will be the means of dividing it, and this will result in much harm to the bees and probably bring about their death.

Mats and Covers.

After heavy rains it is well to examine the mats over the frames. If any damp mats are found, replace with dry ones. A supply of mats should always be on hand. It will only be necessary to gently lift one end of the cover to discover the condition of the mat, and this can be done without disturbing the bees.

All covers that are not absolutely rainproof should receive attention. No better covering for roofs can be had than sheet lead. Such covers are costly to commence with but are rainproof, and do not require

to be secured in windy locations. If lead is found too expensive cover the roofs with zinc or ruberoid. The latter material should be heated before being fixed to the roofs.

Removing Spare Top Boxes.

All the top boxes that have not yet been removed should now be taken off and the bees confined to the brood-chambers. Breeding will commence shortly in colonies of normal strength in the warmer parts of the Dominion, and the hives should be made snug with well-fitting mats to conserve the heat of the hives. If it is found that the bees have taken to a top box entirely, remove the lower one and put the former in its place.

Control of Wax-moth Pest.

In districts where wax-moths are troublesome, particularly the large one (*Galleria mellonella*), a periodical examination should be made of all extracting combs. These moths do a great amount of damage, particularly in the off season, and especially in districts where mild weather conditions prevail. The moths not only attack the dry combs, but also combs of honey stored for spring feed.

Where the moth is prevalent in large numbers a special comb-room is essential, constructed so as to be nearly airtight, and filled with racks on which to suspend the combs to enable fumigants to penetrate the cells. Where only a few combs have to be dealt with these may be stacked in supers, spaced eight to the super, care being exercised to see that the junctions of the boxes are made smoketight by pasting a strip of paper round them. The top box of the pile should contain no frames. In this place an iron saucepan containing wood embers, and on these throw a small quantity of sulphur. Close the supers securely, and keep closed for a couple of days. In three weeks to a month a second fumigation should be given.

Bisulphide of carbon may be used to accomplish a similar result. In using this chemical the combs can be stacked in a tight box or placed in supers. If the latter are used all cracks require to be closed with paper pasted on the outsides to prevent the fumes from escaping. Place a quantity of the bisulphide in an open dish on top of the combs. The liquid evaporates and the fumes, being heavier than air, settle over the combs, thus effectively killing the moths. This operation may have to be repeated during the winter months. Great care must be exercised when using the bisulphide, as it is highly explosive and dangerous, and on no account must a fire or light be allowed near the liquid when being used.

Beekeepers who have constructed special rooms for the storage of combs during the winter report excellent results in keeping moths under control by the use of Cyanogas (calcium cyanide). Fumigation by this agent can be easily undertaken, and if one dose is not sufficient to destroy the insects further doses of the gas can be given at very little cost.

The active agent of calcium cyanide is liberated in the form of hydrocyanic acid gas, which is a most deadly poison to all life. However, it can be used with safety because the liberation from the powder of the gas is slow, thus allowing the operator to retire after giving a charge. Fumigation of combs may be done in supers, after taking the precaution of making them gastight, in the same way as when using sulphur or bisulphide. In the event of a comb-room being used the supers containing the combs can be stacked criss-cross or placed on the racks usually provided. No other preparation is necessary. In operation the calcium cyanide powder should be sprinkled on paper and placed under the tiers of supers, or here and there about the buildings. For fumigation of supers it is recommended to use a dose of 4 lb. to 100 cubic feet of space. Half the quantity will suffice for airtight comb-rooms. These dosages will kill the moths in all stages.

As already indicated, the gas, being deadly to all life, must be handled with great care. Caution is necessary when the chemical is used in buildings. The operator should leave the building as soon as possible, and lock the doors and windows. Twenty-four hours' treatment will suffice, after which the door of the room should be opened to allow the gas to escape, the building not being entered for from two to three hours.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Draining the Land.

In our pursuit of new knowledge we are inclined to neglect the old, to take great interest in such things as new chemical sprays and manures and neglect the fundamental needs of successful cropping. Possibly it is because it looks easy, and there is a hope that it will supersede the more laborious methods. Exceedingly valuable as new chemical sprays and manures have proved, there is little evidence that they can take the place of cultivation and thorough preparation of the land.

Land that is badly drained is usually in an extreme state of being either excessively dry, hard, and cracking, or saturated with stagnant moisture. In either case it is obviously unfertile. But during brief intervals between these periods of extremes, and in cases where the condition is not quite so marked, we sometimes allow ourselves to be persuaded that it will "do." Such land as is under consideration is of good quality, usually situated in an expensive locality, and to spend time and money on the production of poor crops is not a pleasing prospect. There should be no doubt about the question of drainage, as no commercial crop can be grown satisfactorily without it, no matter how good the land may otherwise be. On most heavy soils this treatment will give better results than any other single factor.

At the present time clearing and repairing drains should be carefully done with a full recognition of its importance. Even pipe draining is sometimes needed. This should be done after careful planning, which should be duly filed in the log-book. It is not sufficient to bury the pipes to get results; it is necessary to lay them in the same plane, with a suitable fall, depth, and interval. If one has assistance in doing this work it is a good plan to make it a rule that no trench is to be filled until it has been inspected.

A weak point in drainage systems commonly met with is either the absence or insufficiency of culverts under gateways and roads to connect up open drains and watertables. These are details of the utmost importance and should be tackled resolutely. The fertility of the soil and convenience of working entirely depend upon them.

In a few instances the natural drainage is excessive. In such cases a good loam usually overlies a stony subsoil with a low watertable. Unless the rainfall is high and well distributed, an artificial water-supply and mulching will be needed during dry periods for maximum production.

Shelter for the Crops.

Next in importance to drainage is shelter for horticultural crops. Large-leaved herbaceous and deciduous plants suffer severely in high winds, especially when they are accompanied by rain, unless ample shelter is provided. A single row of cypress, of a species suitable to the district is commonly grown, and proves very effective as a shelter from prevailing winds. Cross-shelter of Lombardy poplar interplanted with barberry,

privet, or holly, &c., to thicken the base is excellent for that purpose; or a wire fence well packed with cut manuka brushwood is useful for immediate effect.

If long and efficient service is expected these lines should be well prepared, and planted with well-graded plants to provide an even, close shelter-hedge. The cultivation should be maintained to ensure early maturity, and prevent weeds and grass killing the lower branches. The present time is very suitable for this class of planting.

Vegetable Crops.

The rainfall during the month of July is generally very considerable, and while the land is wet cultivation should be avoided, or serious damage may be done; but where it is sufficiently warm, and there are indications of growth, and the soil is dry such opportunities should be taken without delay to clean up growing crops and start others that are quite hardy.

Growing crops will consist chiefly of spring cabbage, cauliflower, and lettuce, which, when they have really commenced to make new growth, may be given a dressing of nitrates to assist them. This is best given in small dressings at intervals, and usually better results will be obtained if a small dressing of sulphate of potash is included.

When the land is in condition seedlings of main-crop cabbage, cauliflower, lettuce, and autumn-sown onions should be planted out in land that is rich and well prepared. Also sow main-crop onions, early peas, salads, spinach, and broad beans. Seed-beds of main-crop cabbage and cauliflower may also be made.

Examine stocks of seed potatoes, and see that they are not allowed to sprout unduly or shrivel. If they are in sacks this may be avoided by turning them over and ensuring that the conditions are humid, well ventilated, and sufficiently cool.

Turn in green crops, and complete the preparation of land for planting asparagus, rhubarb, and root crops next month.

Tomatoes under Glass.

Most tomato crops of this kind will still be in the seed-boxes. They are best grown steadily with good root-development. This is best done by giving tepid water moderately and ventilation in warm bright weather. When pricking-out seedlings take a critical glance at each and discard those that are undersized or untrue to type; these are sometimes numerous.

At this season ventilation is probably the most important factor in successful cropping. If neglected, the extremes of heat and cold frequently produce soft plants which are later crippled by a late frost. Careful ventilation in warm weather, keeping the plants hardy, enables them to better withstand a cold snap. This duty is best given to one person, who will be always in the vicinity and so available to adjust the ventilators, which is frequently necessary during the changeable weather of springtime. Early closing about the middle of the afternoon should be the rule at this season.

Preparation of the land in the glasshouse in which tomatoes are to be grown should be now completed, so that it may settle down and consolidate before planting. If, through neglect, the land has been allowed to thoroughly dry out, as it sometimes will do under glass, the ground, including the subsoil, should be saturated with water to bring it back into condition.

Berry-fruit Plantations.

Complete the pruning of small-fruit bushes, giving very careful attention to young plants, so that a good foundation is made without delay. Pruning should be followed up by spraying; an application of bordeaux should invariably be given.

From now on plantations of strawberries will require careful attention as regards cultivation and weeding, until the mulch is laid. Opportunities afforded by intervals of dry weather should be immediately taken for such operations. Shallow cultivation should be given, and all weeds and runners destroyed.

The Homestead Garden.

Where lawns are to be sown the preparation of the land should be completed in time for August seeding. Greens that are worn in places, such as the service-line of tennis-courts, should be repaired by neatly returfing the worn-out patches. A little bone-dust mixed into the soil before laying the turf will assist in making the operation a success.

Carefully examine shelter-belts and shrubberies. Many are spoiled by allowing them to become too crowded, and the better plants become overgrown by those that should have been removed or at least suppressed. Great improvement can often be made by regulating the growth at the present season. The choicer shrubs especially should be given careful pruning, which will be well repaid by the results achieved. Thinning growth, where it has become crowded, and suppressing suckers are two of the main attentions necessary.

Also carefully prune those shrubs recently planted. Thin the growth to open-out the plant, and shorten the growth to invigorate it and make it branch. Conifers, heaths, and rhododendrons usually do not require this treatment. Remove the blossom-spikes from heaths after planting, or, in the case of established plants, when they have done flowering.

Roses also are often pruned in northern districts at this season, but the unusual experience of the last year or two of seeing the new growth cut back by frost will cause some hesitation. Roses growing in localities subject to such visitations should have the pruning deferred for another month.

In the herb garden plant now chives, spearmint, tarragon, and wormwood; also lavender, hyssop, rue, sage, winter savory, and thyme. The number of plants of each should be such as will likely meet the expected demand. Close by prepare land for planting rhubarb and asparagus. These are permanent crops which require a rich soil. Trench the ground and mix in a liberal dressing of decayed farm manure in the lower spit. Strawberries and bush fruits may be planted here now if the land has been well prepared and is free from twitch and other bad weeds.

—W. C. Hyde, Horticulturist, Wellington.

STOCK SLAUGHTERED, 1930–31.

FOLLOWING are the numbers of stock slaughtered at abattoirs, meat-export works, bacon-factories, and ordinary registered slaughterhouses throughout the Dominion during the year ended 31st March, 1931:—

Stock.	Abattoirs.	Meat-export Slaughter-houses.	Bacon-factories.	Ordinary Slaughter-houses.	Totals 1930–31.	Totals 1929–30.
Cattle ..	135,481	124,323	..	66,334	326,128	362,968
Calves ..	45,614	504,220	..	1,926	551,760	440,374
Sheep ..	692,866	2,636,820	..	234,319	3,564,005	3,420,282
Lambs ..	169,632	7,896,328	..	26,842	8,092,802	6,594,635
Swine ..	121,589	273,489	33,267	22,145	449,490	485,907

—Live-stock Division.

WEATHER RECORDS: MAY, 1931.

Dominion Meteorological Office.

General Notes.

The chief characteristics of the weather for May were low rainfall and cool temperatures. But, though temperatures were below normal, the departures were not so marked as in the summer months. On this occasion it was in the North that conditions were, relatively, the more severe. Fortunately, most of the rain which fell was fairly warm, so that pastures benefited considerably. Feed is rather scarce in parts of South Canterbury and Otago, but in almost all other districts supplies are ample, and stock are reported to be in good condition.

Rainfall.—The total rainfall was about equal to the average in the western districts from Westland southwards and in Stewart Island. In all other districts it was below the average. In most, indeed, it amounted only to about half the normal for May. Except in eastern and northern districts, little rain fell before the 18th.

Temperatures.—In the northern and east-coast portions of the North Island mean temperatures were considerably below the average, but farther southwards the normal was gradually approached and finally passed. In Westland and Canterbury conditions were about average, while in Otago temperatures were well above the May normal. Frosts were fairly numerous.

Winds.—The month was a rather windy one, strong winds being experienced from both northerly and southerly directions. These were compensated for by a number of brilliant days with light winds.

Sunshine was above the average.

Pressure Systems.—For a large part of the month the weather was controlled by anticyclones of considerable intensity, and the average pressure was very high. The principal periods of anticyclonic weather were from the 1st to the 3rd and from the 9th to the 17th.

On the 1st southerly gales were blowing in the rear of a cyclone which had crossed the Dominion during the previous night.

Between the 5th and the 9th a cyclonic depression passed between Norfolk Island and the mainland and then moved south-eastwards. Strong southerly winds blew after the centre was to the east of the Dominion, many places experiencing gales on the 8th. The southerlies brought low temperatures, and snow fell on the ranges in the South Island. There were heavy rains in parts of the Auckland Peninsula between the 5th and the 7th.

Another stormy period occurred between the 18th and the 22nd, when a vigorous westerly depression developed a cyclone in its northern portion. The centre of the latter again moved in a south-easterly direction after passing the northern extremity of New Zealand. Heavy rain fell in many places, especially in Auckland Province and on the West Coast. Southerly gales were experienced on the 21st and 22nd, and, as on the 8th, there was snow on the ranges, and hail at many places.

A westerly depression which passed during the 24th and 25th also caused wet and stormy weather. Thunderstorms occurred on the 25th in many parts of the South Island. This depression deepened to the eastward of New Zealand, and was followed by others of the same series, the last passing on the 28th. There were strong southerlies on the 25th, 26th, and 28th, gale force being reached at many places on the day last mentioned. These gales were accompanied by snow on the highlands and numerous showers of hail. Rain was general during the period.

The last storm reached the Dominion on the 30th, a deep cyclone passing the southern extremity on that day. There were boisterous northerly gales and widespread heavy rains.

RAINFALL FOR MAY, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	3·72	13	0·95	7·54
2	Russell	6·18	10	1·44	7·68
3	Whangarei	8·09	18	1·22	8·26
4	Auckland	2·86	14	1·32	4·71
5	Hamilton	1·89	8	0·86	4·89
6	Rotorua	1·59	6	0·82	5·88
7	Kawhia	2·62	10	0·42	5·62
8	New Plymouth	2·34	11	0·60	6·21
9	Riversdale, Inglewood ..	3·89	12	0·97	9·94
10	Whangamomona	3·06	6	0·70	7·17
11	Eltham	2·98	12	0·92	5·30
12	Tairua	3·62	11	1·12	7·96
13	Tauranga	1·74	9	1·02	5·38
14	Maraehako Station, Opotiki	5·52	12	3·48	5·95
15	Gisborne	2·95	14	0·62	5·55
16	Taupo	1·01	6	0·30	4·17
17	Napier	1·63	12	0·36	3·81
18	Hastings	1·65	14	0·36	3·33
19	Taihape	1·70	10	0·53	3·73
20	Masterton	2·22	11	0·52	4·12
21	Patea	0·59	6	0·26	4·41
22	Wanganui	2·23	7	0·66	3·43
23	Foxton	1·31	8	0·51	3·46
24	Wellington	2·56	16	0·75	3·98
	South Island.				
25	Westport	5·15	11	1·26	8·35
26	Greymouth	8·75	13	1·65	8·08
27	Hokitika	7·40	14	1·88	9·81
28	Ross	10·40	11	2·57	10·10
29	Arthur's Pass	17·37	8	4·20	13·29
30	Okuru	11·35	15	2·03	11·06
31	Collingwood	5·28	8	1·55	9·24
32	Nelson	1·51	4	1·10	3·11
33	Spring Creek	1·27	6	0·70	3·07
34	Tophouse	2·35	7	0·68	5·87
35	Hanmer Springs	2·11	14	0·46	4·34
36	Highfield, Waiau	1·98	9	0·42	3·27
37	Gore Bay	2·01	8	0·64	3·48
38	Christchurch	0·70	10	0·23	2·58
39	Timaru	1·02	10	0·44	1·43
40	Lambrook Station, Fairlie ..	0·93	7	0·24	1·50
41	Benmore Station, Clearburn	1·76	10	0·78	1·86
42	Oamaru	0·93	9	0·38	1·62
43	Queenstown	3·03	12	0·93	2·55
44	Clyde	0·71	9	0·15	1·01
45	Dunedin	1·48	13	0·37	3·19
46	Wendon	2·23	12	0·50	2·00
47	Gore	1·88	15	0·59	2·56
48	Invercargill	2·82	15	0·52	4·36
49	Puysegur Point	6·97	22	1·37	6·72
50	Half-moon Bay	5·60	18	1·02	4·64

—*Edward Kidson, Director of Meteorological Services, Wellington, 6/6/31.*

CERTIFICATION OF SEED POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1930–31.

A LIST of growers who have received provisional certificates in connection with the system of Government certification of seed potatoes in the past season is printed below.

Provisional certificates are issued with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their seed. Certification tags to be attached to the sacks are issued later, provided that an officer of the Department of Agriculture inspects the graded seed potatoes, and is satisfied that they are still of the same standard of purity and freedom from disease as was indicated by the field inspection.

NOTE.—Lines entered under the name of the Ashburton Experimental Farm comprise relatively small areas of "selected" seed. Applications for this seed should be made in the first instance to the Fields Superintendent, Department of Agriculture, Auckland, Palmerston North, Christchurch, or Dunedin, as the case may be.

LIST OF GROWERS.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Dakota :—			
Cross, H. E., Sandy Knolls (line B)	10·0	..	5
Jowers, G. C., R.M.D., Springston	10·0	..	5
Walker, C. E., West Melton	10·0	..	4
Gardiner, O. J., R.M.D., Dunsandel	9·9	..	4
Barnett, R., Dunsandel	9·7	..	1
Cross, S., R.M.D., Rolleston	9·4	..	19
McNae, F., R.M.D., Courtenay	9·4	*	5
Hinton Bros., Templeton	9·3	..	20
McPhail, W. A., sen., Mitcham, via Rakaia (line B)	9·2	..	1
Crozier, W. J., Mitcham, via Rakaia (line C)	9·1	..	11
Holmes, W., Rakaia (line C)	8·9	..	1
Murphy, H. E., R.M.D., Weedon's	8·9	..	8
Bishop, W. J., R.M.D., Southbridge	8·8	..	1
Cree, D. J., P.O., Burnham (line A)	8·8	..	1
Gee, W., Springlands, Blenheim	8·8	*	9
Marshall, D., R.M.D., Killinchy	8·8	..	1½
Doak, J. H., Barrhill, Rakaia	8·7	*	1½
McVinnie, D., R.M.D., Weedon's	8·7	..	2½
Eder, W., R.M.D., Sefton	8·6	..	11
Kelly, M. S., Lincoln Road, Halswell	8·6	*	5
Buchanan, I. K., R.M.D., Irwell	8·5	..	5
Holmes, W., Rakaia (line A)	8·5	..	3
Ford, S., Templeton	8·3	..	1
Curragh, J., Templeton	8·2	..	4½
Upston, E. E., Selwyn	8·2	..	2
McGregor, M., Windermere	8·1	..	4
Butcher, D. and M., R.M.D., Broadfields	8·0	..	1
Gudex, G., Levels	8·0	..	3
Munro and Scarth, Barrhill, Rakaia	8·0	..	5
Knox, H., Tinwald	7·9	*	13
Phillips, W., R.M.D., Springston	7·9	..	1
Cree, D. J., P.O., Burnham (line B)	7·8	..	4

* Crop approaching the maximum percentage of foreign varieties allowable.

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Dakota—continued.			
Marshall, H. M., R.M.D., Weedon's (line C)	7·8	..	2
Vedder, G., Templeton	7·8	..	2
Burrowes, J., Mitcham, via Rakaia	7·7	..	11
Smythe, H., care of G. G. Wanson, Darfield	7·7	..	2
Breakwell, A. J., Tinwald (line B)	7·6	..	10
Deans, J., Coalgate	7·6	..	2
Hearn, F. W., Rangitata Island	7·6	..	1
Argyle, J., Allenton, Ashburton	7·5	..	2½
Dolan, M., Leeston	7·5	..	1
Robson, F. H., Lincoln	7·5	..	1
Stubbs, J. D., Rakaia	7·5	*	5
McLachlan, G., R.M.D., Southbridge	7·4	..	1
Seyb, G., Washdyke, Timaru	7·4	..	1
Seyb, L., Washdyke, Timaru	7·4	..	10
Cross, H. E., Sandy Knolls (line A)	7·3	..	3
Hardy, A., Winchmore	7·3	..	13
Tweedy, S., R.M.D., Dunsandel	7·3	..	3
Holmes, W., Rakaia (line B)	7·2	..	1
McPhail, W. A., jun., Mitcham, via Rakaia	7·2	..	6
McPhail, W. A., sen., Mitcham, via Rakaia (line A)	7·2	..	12
Shellock, W., R.M.D., Te Pirita	7·2	..	4
Steele, J., Kimberley	7·2	..	1
Kempthorne, O. C., Coutts Island	7·1	..	5
Boag, R. A., Hatfield, Rakaia	7·0	..	1
Oldfield, E. C., P.O., Seadown	7·0	..	2
Watts, H., Willowby	7·0	..	2

The cropping-powers (in tons per acre) of those lines which have been rejected or withdrawn are as follows: 9·0, 7·6, 7·1, 7·0, 6·8, 6·8, 6·8, 6·8, 6·7, 6·7, 6·5, 6·4, 6·4, 6·4, 6·3, 6·3, 6·2, 6.2, 6·1, 6·0, 6·0, 6·0, 6·0, 6·0, 5·9, 5·8, 5·7, 5·6, 5·6, 5·5, 5·4, 5·3, 5·2, 5·1, 5·1, 5·0, 5·0.

* Crops approaching the maximum percentage of foreign varieties allowable.

Aucklander Short-top :—			
Marshall, D., R.M.D., Killinchy	10·2	0·8	9
Rose, C. W., Middle Park Road, Riccarton	10·2	0·3	1
Ashburton Experimental Farm	10·0	..	..
Oakley, W., R.M.D., Halkett	9·9	..	4
Crump, F., Springston	9·4	1·2	1
Allison, J., R.M.D., Courtenay	9·2	0·3	1½
Canterbury Seed Co., Leeston (line A)	9·2	..	5
Marshall, H. M., R.M.D., Weedon's (line B)	9·2	0·5	1
Redmond, C., R.M.D., Kimberley (line A)	9·2	0·6	8
Jellie, J., Russley Road, Fendalton (line A)	9·1	..	4
Nairn, G., Lakeside	9·1	..	1
Hancock, H. A., Awahuri, via Palmerston North	9·0	0·3	8
Roper, R. S., R.M.D., Halkett	9·0	1·2	1½
Canterbury Seed Co., Leeston (line B)	8·8	..	3
Petrie, J., jun., Swannanoa (line D)	8·8	0·3	2
Petrie, J., sen., Swannanoa	8·8	0·3	2
Rich, A. J., R.M.D., Kaiapoi	8·8	..	18
Barnett, R., Dunsandel (line A)	8·7	1·0	8
Breakwell, A. J., Tinwald	8·6	..	1
Busch, W. S., R.M.D., West Eyreton	8·6	1·4	1
Cooper, J., R.M.D., Leeston	8·5	..	1
Swanston, W., Selwyn	8·5	0·5	1
Warren, J., 149 Russley Road, Fendalton (line A)	8·5	0·5	8
Barnett, R., Dunsandel (line B)	8·4	..	4
Carroll, A. D., R.M.D., Southbridge	8·4	..	5

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Aucklander Short-top—continued.			
Cross, S., R.M.D., Rolleston (line A)	8·4	..	1
Moore, H. S., Box 4, Kaiapoi	8·4	..	11
Smith, E. A., R.M.D., Springston	8·4	0·6	8
Bishop, R. G., R.M.D., Southbridge	8·3	..	2
Claridge, F. W., 103 Claridge's Road, Papanui	8·3	..	1
Clarke, L. W., Styx	8·3	..	1½
Ireland, J., Broadway Avenue, Palmerston North	8·3	0·8	7½
Redmond, C., R.M.D., Kimberley (line B)	8·3	0·6	1
Relling, H., R.D., Tycho, Timaru	8·3	1·6	1
Seyb, L., Washdyke, Timaru	8·3	0·3	2½
Brown, A. F., Woolridge Road, Harewood (line A)	8·2	0·2	1
McPhail, W. A., jun., Mitcham, via Rakaia	8·2	..	1
O'Loughlin, A., Springbank	8·2	..	1
Court, R., Swannanoa	8·1	0·5	4
Gudex, G., Levels	8·1	0·8	1½
Petrie, J., jun., Swannanoa (line A)	8·1	1·0	3
Vaughan, H. S. F., Woodend	8·1	0·4	2
Woods, A. R., R.M.D., Springston	8·1	..	2
Brundell, F., Camside, Kaiapoi	8·0	0·4	2½
Eder, W., R.M.D., Sefton	8·0	..	11
Marshall, H. M., R.M.D., Weedon's (line A)	8·0	0·3	1
Cross, S., R.M.D., Rolleston (line B)	7·8	..	1
Muff Bros., Orari (line A)	7·8	..	1
Needham, M. R., North Road, Kaiapoi	7·7	0·2	1
Rangiora High School, Rangiora	7·7	0·6	1
McVinnie, D., R.M.D., Weedon's	7·6	..	1½
Walker, C. E., West Melton	7·6	..	2
Croucher, C. M., Tiakitahuna, Palmerston North	7·5	0·5	2
Martin, W. E., R.M.D., Kaiapoi (line A)	7·5	0·5	14
Martin, W. E., R.M.D., Kaiapoi (line B)	7·5	0·6	20
Sings, W. T., Seedsman, Oamaru	7·5	..	1
Warren, J., 149 Russley Road, Fendalton (line B)	7·5	1·2	6
Cross, H. E., Sandy Knolls	7·4	0·2	1
Jellie, J., Russley Road, Fendalton (line B)	7·3	..	4
Nutt, H. A., Motukarara	7·3	0·2	2½
Breen, M., Levels	7·2	0·2	10
Brown, A. F., Woolridge Road, Harewood (line B)	7·2	0·2	1
King, W. H., R.M.D., Rosewill, Timaru	7·2	..	1
Robinson, R. G., Papanui	7·1	0·5	1
Weeber, H., Englefield Road, Belfast	7·1	..	3
Gardner Bros., Upper Waitohi, via Temuka	7·0	1·2	1
Shea, H., Makikihi	7·0	..	1
Stewart, G., Orari	7·0	0·3	1
Breading, F. W., R.M.D., Te Pirita	6·9	..	1
Cox, S., Willowbridge	6·9	..	1
Richards, J., Salisbury	6·9	..	1
Stowell, D., St. Andrew's	6·9	1·0	1½
Watts, H., Willowby	6·9	..	1
Weeber, F., Englefield Road, Belfast	6·9	..	3
Haines, C., 108 Waimak Road, Harewood	6·8	1·4	2
Petrie, J., jun., Swannanoa (line E)	6·8	0·8	5
Ferguson, J. W., Upper Winchmore, Methven (line A)	6·7	..	35
Ferguson, J. W., Upper Winchmore, Methven (line B)	6·7	..	1
Harris, G., Milford, Temuka (line B)	6·7	0·7	1½
Seifert, H. A., 33 North Street, Palmerston North (line B)	6·5	0·5	2

The cropping-powers of those lines which have been rejected or withdrawn are as follows: 9·6, 9·0, 8·4, 8·2, 8·0, 7·7, 7·1, 6·4, 6·3, 6·3, 6·3, 6·2, 6·2, 6·2, 5·8, 5·8, 5·8, 5·8, 5·8, 5·5, 5·5, 5·4, 5·4, 5·4, 5·3, 5·3 5·2, 5·1, 5·1, 4·6 3·8.

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Aucklander Tall-top :—			
Ashburton Experimental Farm	10·8	..	..
Warren, J., 149 Russley Road, Fendalton	10·6	0·5	20
Seyb, G., Washdyke, Timaru	10·5	0·8	1
Seyb, L., Washdyke, Timaru	10·5	0·8	4½
Doak, J. H., Barrhill, Rakaia	10·2	1·7	2
Steele, D., R.M.D., Ohoka	10·2	..	3
Breakwell, A. J., Tinwald	10·1	1·0	1
Tweedy, S., R.M.D., Dunsandel	9·8	0·5	1
Heckler, J. L., Ihuraua, Mauriceville, via Masterton	9·7	0·3	1
Buchanan, I. K., R.M.D., Irwell	9·6	..	1
Moore, H. S., Box 4, Kaiapoi	9·6	0·8	15
Simmons, W., Kingsdown, Timaru	9·5	2·0	2
Crowe, E., Waimate	9·4	0·2	1
Deans, J., Coalgate	9·4	..	1
Dulieu, H. P., Taitapu	9·4	..	1
Hampton Bros., Pareora, via Timaru	9·4	0·2	1½
Oldfield, E. C., P.O., Seadown	9·4	..	1
Smith, F., Arowhenua, Temuka	9·4	..	3
Moynahan, W., East Road, Shannon, via Levin	9·3	..	2
Fahey, W., Rangiora	9·2	..	3
Bailey, J., R.M.D., Kaiapoi	9·1	..	5
Doak, A., Rangiora	8·9	1·2	4
Hewitt, D., Woodend	8·9	0·3	9
Cross, H. E., Sandy Knolls	8·5	0·5	2
Marshall, W. H., Prebbleton	8·2	..	1

The cropping-powers of those lines which have been rejected or withdrawn are as follows : 9·2, 8·7, 8·1, 8·1, 7·8, 7·2, 6·1, 5·6, 5·5.

Bresee's Prolific :—			
Carpenter, F. W., Prebbleton	8·0	0·3	30
Seyb, L., Washdyke, Timaru	7·7	0·3	4
Carr, J., Methven	7·5	..	1½
Marshall, D., R.M.D., Killinchy	7·3	0·3	32
Pierce, G., R.M.D., Killinchy	7·2	0·5	6
Allen, A., R.M.D., Killinchy	6·9	0·4	20
Chappell, W., R.M.D., Killinchy	6·7	0·7	2
Donald, W. L., Doyleston (line A)	6·2	0·8	11

Cropping-powers of lines rejected and withdrawn : 7·2, 7·0, 7·0, 6·1, 5·6, 4·9.

King Edward :—			
Rose, A. H., Glencoe R.D., Invercargill	7·8	..	1
Burgess, D., West Plains	7·4	..	2
Caulfield, J. L., Rakahauka R.D., Glencoe, Invercargill	7·3	0·2	1
Ashburton Experimental Farm	7·2	..	..
Gore Experimental Farm, Gore	6·8	..	2½
McLeary, J., Mataura Island	6·6	0·4	1½
King, R. M., Happy Valley, Tuatapere	6·3	..	3
McNaught, A. S., Rakahauka R.D., Glencoe, Invercargill	6·3	0·7	1
Anderson, A., Stirling (line B)	6·2	0·5	2½
Brown, W. E., Orepuki	6·2	..	2½
Mosley, O. S., Stirling	6·1	0·7	8
Ross, M. G., Palmerston South	6·1	0·3	1
King, L. A., Rakahauka R.D., Glencoe, Invercargill	6·0	..	2
Knowler, C. E., Happy Valley, Tuatapere	6·0	..	2½

Cropping-powers of lines rejected and withdrawn : 5·8, 5·6, 5·3.

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Arran Chief :—			
Knowler, C. E., Happy Valley, Tuatapere	8·1	0·6	2½
Wright, L. T., Annat	7·7	1·0	2
Frazer Bros., Southbrook	7·5	..	9
Jones, F. E., Halswell	7·5	0·2	2
Townshend, A. C., View Hill, Oxford	7·5	0·2	2
Cropping-powers of lines rejected and withdrawn: 7·9, 7·8, 7·4, 7·2, 7·0, 6·7, 6·4, 6·4, 6·3, 6·2, 6·0, 5·9, 5·3, 4·6, 3·8.			
Epicure :—			
McLachlan, G., Southbridge	7·3*	..	32
Jellie, J., Russley Road, Fendalton, Christchurch ..	6·3*	..	1
Spillane, A., John Street, Temuka	6·0*	..	1
Shellock, W., R.M.D., Te Pirita	5·3	..	8
Marshall, D., R.M.D., Killinchy	5·2	..	10
Ashburton Experimental Farm	4·9	..	..
Breading, F. W., R.M.D., Te Pirita	4·7	..	1
Wright, L. T., Annat (line A)	4·7	..	1
Wright, L. T., Annat (line B)	4·5	..	1½
Cropping-powers of lines rejected and withdrawn: 6·6,* 2·6.			
* Line taller-growing and rather later-maturing than the usual type of Epicure, but not a "bolter."			
Majestic :—			
Ashburton Experimental Farm	9·0	..	..
Borthwick, R., Darfield	6·9	1·2	1
Clark, A. J., Rangiora	6·8	0·5	11
Cropping-powers of lines rejected and withdrawn: 7·4, 6·7.			
Up-to-Date :—			
Ashburton Experimental Farm	13·0	..	..
Tutton, F. A., R.M.D., Broadfields	10·9	..	1
Kokay, S., Tuatapere	10·0	..	5
Walker, C. E., West Melton	10·0	..	4
Norman, H. D., Tuatapere	9·4	..	1
Cropping-powers of lines rejected and withdrawn: 5·9, 5·7, 5·5.			
Field Marshal :—			
Ashburton Experimental Farm	11·7	..	..
Wright, L. T., Annat	11·4	..	7
Cropping-power of line rejected: 8·7.			
Early Regent :—			
Eder, W., R.M.D., Sefton	6·4	..	1
Ashburton Experimental Farm	5·9	..	..
Clarke, L. W., Styx	5·7	0·4	1½
Curragh, J., Templeton	5·2	..	3½
Cropping-powers of lines rejected: 3·5, 3·4, 3·0.			

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Iron Duke :—			
Buchanan, I. K., Irwell	9·5	..	1½
Spillane, A., John Street, Temuka	8·3	..	1
Seifert, H. A., 33 North Street, Palmerston North ..	8·1	..	4
Herridge, F. G., Woodend	8·0	0·2	2
Buchanan, A. R., "Lockwood," Kairanga, Palmerston North	7·5	..	1
Hancock, H. A., Awahuri, via Palmerston North ..	6·5	..	14
Cropping-power of line rejected: 7·3.			
Early Rose :—			
Brown, A. F., Woolridge Road, Harewood	8·5	..	1
Busch, W. S., R.M.D., West Eyreton	7·6	0·7	1
Burns, R. A. C., R.M.D., Te Pirita	7·5	..	2
Cropping-power of line rejected: 7·1.			
Great Scot :—			
Ashburton Experimental Farm	9·3	..	..
Spillane, A., John Street, Temuka	6·8	..	4
Kerr's Pink :—			
Ashburton Experimental Farm	8·0	..	..
Watts, H., Willowby	7·4	..	1
Endurance :—			
Burns, R. A. C., R.M.D., Te Pirita	11·2	..	1½
Weaver, J. H., R.M.D., Te Pirita	11·2	..	2
Weaver, H., R.M.D., Te Pirita	10·7	..	4
Ally :—			
Ashburton Experimental Farm	6·0	..	..
Clark, A. J., Rangiora	4·7	1·3	2
Robin Adair :—			
Marshall, D., R.M.D., Killinchy	7·5	..	7
Jellie, J., Russley Road, Fendalton	5·3	..	1
Cropping-power of line rejected: 3·2.			
Golden Wonder :—			
Ashburton Experimental Farm	5·3	..	..
Arran Banner :—			
Ashburton Experimental Farm	11·7	..	..
Abundance :—			
Ashburton Experimental Farm	9·2	..	..
Arran Consul :—			
Ashburton Experimental Farm	8·1	..	..
British Queen :—			
Ashburton Experimental Farm	5·9	..	..

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Sharpe's Express :—			
Ashburton Experimental Farm	4·3	..	..
Duke of York :—			
Ashburton Experimental Farm	3·3	..	..

Cropping-powers of miscellaneous varieties withdrawn or rejected: Witchill, 3·9; Early Puritan, 2·3; Herald, 1·8; Maori Chief, 6·6; Northern Star, 8·3, 7·0, 5·0.

NOTE.—Of the varieties listed above, the following will not be eligible for certification in the 1931–32 season: Golden Wonder, Duke of York.

—*Fields Division.*

DAIRY FACTORIES IN NEW ZEALAND, 1930-31.

THE following table presents the registrations of factories under the Dairy Industry Act as at 31st March last, together with the quantities of butter and cheese forwarded to grading-stores for export during the year ended 31st March, 1931, and the numbers of milk or cream suppliers to the factories during the same period :—

District.	Number of Factories.				Forwarded for Export, 1930-31.		Number of Suppliers to Factories.	
	Butter.	Cheese.	Dual Plant.	Total.	Butter.	Cheese.	Butter.	Cheese and Dual Plant.
					Tons.	Tons.		
Auckland ..	63	37	4	104	64,412	17,485	20,035	1,536
Taranaki ..	18	70	37	125	10,679	38,363	3,079	3,982
Wellington ..	19	48	9	76	10,214	13,415	5,687	1,768
Hawke's Bay ..	9	17	1	27	3,753	3,845	4,059	716
Nelson	5	3	1	9	1,281	669	1,281	725
Marlborough ..	3	2	3	8	656	848	753	197
Westland ..	10	2	..	12	474	34	615	9
Canterbury ..	9	14	3	26	1,340	2,036	4,691	1,586
Otago and Southland	11	77	1	89	1,162	14,265	6,706	3,320
Totals, 1930–31	147	270	59	476	93,971	90,960	46,906	13,839
Totals, 1929–30	150	273	54	477	91,467	84,663	45,592	13,825

Whey butter was manufactured as a side-line at eighty-one of the above cheese-factories in 1930–31, the total quantity forwarded for export being 1,387 tons. This is not included in the total amount of 93,971 tons of butter given in the table, which refers to creamery butter only.

In the 1929–30 period there were also operating in the Dominion five milk-powder factories (two whole-milk and three skim-milk plants), seven casein-factories, two condensed-milk factories, and one sugar-of-milk factory.

Bean Wilt.—By Order in Council, gazetted in April, bean wilt (*Bacillus Phaseoli*) was declared to be a disease within the meaning of the Orchard and Garden Diseases Act, and included in the First Schedule.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SALT-LICK FOR BREEDING-EWES.

J. H. P., Ashburton :—

What would be a good salt-lick mixture for breeding-ewes feeding on turnips? Would phosphate be of any advantage in the mixture?

The Live-stock Division :—

The value of a lick for stock depends upon the deficiency in the soil of the particular mineral or minerals attempted to be replaced by the lick. Apart from natural deficiency, the farming methods adopted must also be taken into account. For example, where the application of superphosphate and lime has been extensively adopted there would be less need for a lick containing those minerals than where no top-dressing has been done. The following lick can be recommended for sheep: Salt, 40 lb.; bone-meal, 38 lb.; air-slaked lime, 15 lb.; sulphate of iron, 2 lb.; sulphur, 5 lb. If top-dressing has been practised difficulty may be found in getting the sheep to take to this lick, in which case the bone-meal or lime could be reduced. Bone-meal contains phosphate, and is to be preferred in a lick mixture.

CONTROL OF GRASS-GRUB IN PASTURES.

"SUBSCRIBER," Waiau :—

Is there any treatment for grass paddocks infested with grass-grubs which would stop the grubs from destroying the grass? I have some one- and two-year-old grass paddocks infested. I have rolled some of the autumn-sown paddocks about three months after sowing, and it seems to check the grub for a time.

The Fields Division :—

The treatment of pastures for the control of grass-grub is a problem which has engaged the attention of agriculturists and others for a number of years, but so far no satisfactory method of dealing with large areas has been devised. Rolling certainly helps to some extent, its chief benefit being due to the fact that by consolidating the ground it encourages fresh root-growth of affected grass-plants. Any actual destruction to the grubs themselves is more likely to be done by the horses' hoofs than by the roller. Where infestation is confined to patches a few handfuls of grass-seed scattered over the ground before rolling will help matters, as the grass will germinate readily and provide new plants. On dairying-country feeding out hay to stock on affected areas is a recognized practice. If the hay contains some seeds of the better grasses it has the additional benefit of providing a fresh sole of grass. There is no doubt that pasture-management has considerable value as a means of control. Pastures which are well grazed between the months of November and January are seldom infested to the same extent as those allowed to get away at this period. The beetles have a liking for pastures carrying a roughage in which to lay their eggs. Such pastures afford shelter from the weather as well as protection from the hoofs of stock.

CUTTINGS FROM HEDGE OF SEEDLESS BARBERRY.

"BARBERRY," Karioi :—

We planted a hedge of seedless barberry in July, 1928. Would it be safe to take a few cuttings from them? If so, can they be planted out to form another hedge, or must they be stuck in a close row to form roots, and then be transplanted next winter.

The Horticulture Division :—

It will be quite satisfactory to take cuttings from the hedge of seedless barberry you mention. However, the cuttings should not be planted out immediately to form a hedge, but planted in nursery rows in a somewhat shaded position. Twelve months later most of them will have rooted and be ready for planting out. Make the cuttings now, about 8 in. long, and plant them so that only two buds are above the ground. Keep the plants weeded while they are in the nursery beds.

CLEAN GRAZING FOR CALVES.—TREATMENT FOR FOOT-ROT IN COW.

"READER," Mosgiel :—

(1) Will a paddock spelled for nine months from grazing by calves and lambs be suitable for calves with regard to danger from parasites? Cows were grazed on it during the nine months.

(2) Would bluestone solution be beneficial for a cow's hoof which seemed infested with foot-rot?

The Live-stock Division :—

(1) Parasites give the most trouble on permanent pasture, especially if this is low-lying and poorly drained, and also if it has been rather heavily stocked with either calves or lambs, as the case may be. The young parasites may remain alive on the ground for a long period, but the great majority will have perished if a paddock is kept free of cattle or sheep for twelve months. Adult animals are much more resistant to parasitic infestation, and if no other pasture is available the paddock you mention would be reasonably safe, especially if you provide some good nourishing dry feed during the winter, and do not let the calves get low in condition. The more ideal pasture, of course, to turn young calves on to would be a new grass paddock, or one where no cattle or sheep have grazed for the past twelve months.

(2) An application of a 10-per-cent. solution (2 oz. bluestone to 1 pint of water) would be beneficial in a case of foot-rot. Whatever treatment is adopted, it is of fundamental importance to cut away any diseased tissue and broken horn, and also equally important, after treatment, to protect the foot from dirt contamination by applying a protective bandage.

DODDER IN LUCERNE.

J. H. P., Ashburton :—

Would you let me know if dodder will kill lucerne, and, if so, what would destroy the dodder or prevent it from spreading, as I have a few patches in my lucerne.

The Fields Division :—

This parasitic plant obtains its nourishment from the host plant (lucerne); therefore you will see that it is capable of doing very great damage to lucerne stands. In many cases the lucerne will die out because the dodder withdraws from the lucerne-plants the food that should go to nourish them. In Canterbury many promising stands have had to be ploughed up owing to attacks of dodder. When patches appear they should be cut at once, and burned with the aid of some dry straw or other suitable material. Various remedies have been tried in connection with the destruction of dodder, but most have been entirely ineffective. Sulphate of iron—two sprayings at a strength of 10 per cent.—was tried in Canterbury some years ago, and appeared to be fairly effective. A strength of 10 per cent. represents 2 lb. sulphate of iron to 2 gallons water. If you have only got one or two patches the burning of such will probably free your stand from the weed.

Poultry Diseases declared.—The following diseases affecting poultry have been declared to be diseases for the purposes of the Poultry Act, 1924: Bacillary white diarrhœa, coccidiosis, fowlpest (*Pestis gallinarum*), pseudo-fowlpest (or Newcastle disease).

THRESHING RETURNS OF WHEAT AND OATS.

TABULATED below are particulars of threshings of this season's wheat and oat crops, covering the period January–April, 1931, compiled by the Census and Statistics Office from returns received up to 19th May:—

Land District.	Wheat.					
	Firsts.			Seconds.	Total threshed.	Average Yield per Acre.
	Tuscan or Longberry.	Hunters (Velvet varieties).	Pearl or Velvet.			
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels
Gisborne ..	830	..	..	52	882	51·88
Hawke's Bay ..	16,333	..	80	501	16,914	24·80
Taranaki ..	1,301	..	..	34	1,335	39·26
Wellington ..	77,775	13,913	5,335	4,177	101,200	44·48
Nelson	16,562	18,212	902	2,188	37,864	30·91
Marlborough ..	82,498	25,352	19,056	9,556	136,462	31·99
Canterbury ..	3,299,221	676,475	140,783	235,635	4,352,114	31·13
Otago	313,022	236,143	70,931	38,079	658,175	34·63
Southland ..	17,671	270	2,313	820	21,074	23·68
Totals ..	3,825,213	970,365	239,400	291,042	5,326,020	31·67

Land District.	Oats.					
	White.	Dun.	Black.	Algerian.	Total threshed.	Average Yield per Acre.
	Bushels.	Bushels.	Bushels	Bushels.	Bushels.	Bushels.
Gisborne ..	..	..	..	300	300	42·86
Hawke's Bay ..	1,830	..	..	6,509	8,339	32·07
Wellington ..	6,392	1,262	560	37,470	45,684	44·35
Nelson	390	710	..	7,724	8,834	35·44
Marlborough ..	3,411	..	1,984	31,031	36,426	39·61
Canterbury ..	532,855	147,198	24,025	288,121	992,199	36·77
Otago	408,547	45,329	23,892	37,953	515,721	50·42
Southland ..	295,318	15,690	2,747	..	313,755	53·31
Totals ..	1,248,743	210,189	53,208	409,108	1,921,248	42·17

FORTHCOMING WINTER SHOWS.

South Taranaki Winter Show Company: Hawera, 30th June to 4th July.
Auckland Winter Exhibition: Auckland, 8th to 18th July.
Canterbury A. and P. Association: Christchurch, 8th to 22nd August.
Wellington Winter Show Association: Wellington, 27th August to 12th September.

Header-harvesters.—According to the Fields Superintendent for the district, forty-two header-harvesters were at work in Canterbury this season. On one farm 2,000 bushels of wheat were harvested in one day with two 8 ft. machines, the contract price being 9d. per bushel.